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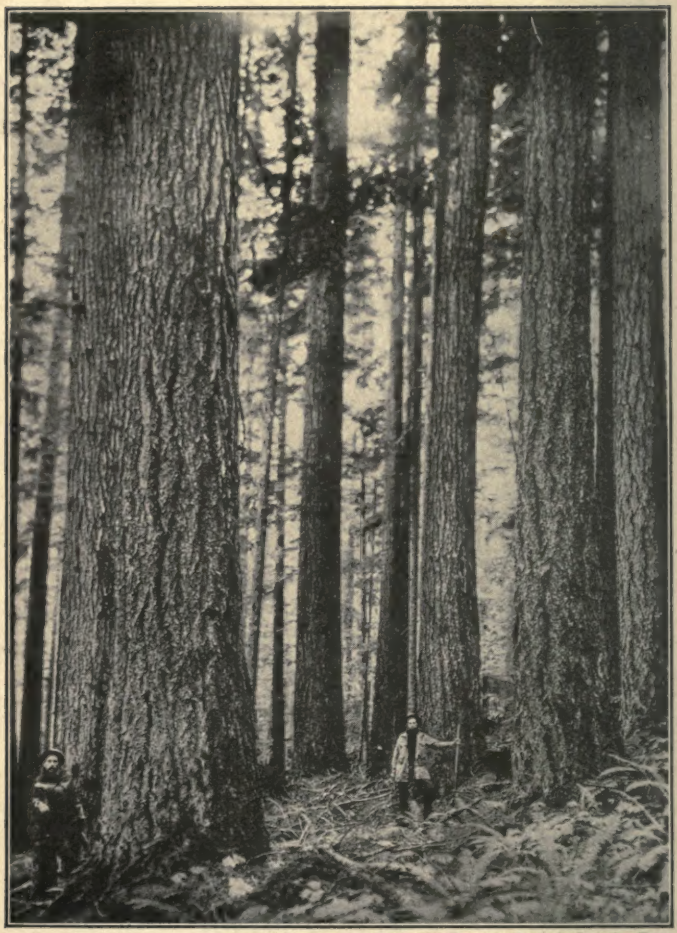

Courtesy Forestry Branch, Interior Dept.

Douglas Fir, Showing the Large, Clear Trunks Characteristic of the Tree.

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FORESTS AND TREES

BY

B. J. HALES, B.A., LL.B.

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PREFACE

THIS book has been written to assist in impressing upon the young the value of our forests and to give them some appreciation of what is being done, as well as of what must yet be done, in order to preserve them. It is not a handbook on forestry, but contains interesting information which, it is hoped, will tend to create a healthy public opinion regarding the use and care of trees.

While the book is really the expression of that appreciation of trees which comes only from long and intimate acquaintance, yet the literature on the subject has been freely used, and the author wishes to acknowledge the help received from the following: Sargent's "Manual of the Trees of North America"; Britton's "North American Trees"; Fernow's "Care of Trees"; Britton and Brown's "Illustrated Flora of the Northern States and Canada"; "Gray's New Manual of Botany" by Robinson and Fernald; Rydberg's "Flora of the Rocky Mountains and Adjacent Plains"; Coulter and Nelson's "Rocky Mountain Flora"; and Macoun's "Catalogue of Canadian Plants."

Very particular mention should also be made of the many excellent publications of the Forestry Branch of the Department of the Interior; and special thanks are due to Mr. R. H. Campbell, Director of Forestry, for valuable suggestions and assistance, as well as for a very careful and suggestive reading of the proof sheets by the staff of the Forestry Branch.

B. J. H.

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PART I

FORESTS

CHAPTER I

THE FOREST AND LIFE

"The forests of America must have been a great delight to God; for they were the best he ever planted." — JOHN MUIR.

How bare and parched the world would be without the forests! Trees are the earth's natural clothing. They protect it from the scorching sun and the withering blast, keep the water in the streams and spread freshness and greenness all around. Woods and water are always found together; the one helps the other; and together they help all other things. The great rivers of the world take their rise in forests, and no great lake is found except where trees are plentiful. Little lakes, too, in great numbers nestle among the trees and one of the commonest woodland sounds is the voice of running water. Dryads and nymphs, the goddesses of trees and streams, are always thought of together. If, then, the waters are not to dry up and leave the world parched and barren, we must see that the forests which preserve them are not destroyed.

A forest is not merely a collection of trees. It is a community of living beings that struggle and live and die as men do, each doing its share for the good of all, though

some rob others of air and sunshine and food, even as people are robbed. Trees, like men, succeed or fail; some die young, some struggle on, scarred or dwarfed or broken by the forces with which they contend; many reach middle age, while a few live to be very old or grow to a great size. With trees as with men only a few become really old or really great. But the forest lives on, and the dead bodies of trees that die, the roots in the earth and the leaves that fall on the surface, all go back to the soil, making it rich and mellow so that other plants may live. It took perhaps millions of years to supply the fertility that is stored up in a few inches of the surface soil, and man often wastes this in a few seasons, or allows it to be burned off in a few hours.

All animal life, too, depends on the trees for food, shelter or protection. A few of the larger beasts sought the open and for a time became numerous. The bison grew fat and multiplied, nourished by the rich grass of the prairies and, migrating in immense herds, were apparently lords of the domain over which they trod. They defied the frosts and the fires; the floods and the droughts left their numbers apparently unchanged. They seemed perfectly suited to their surroundings and their numbers were limited only by the extent of their pasture. The first serious enemy they met was man, and in a few years they were gone. Exposed to attack on all sides, unprotected by trees and the course of their enemies unimpeded, they could not stand the struggle and only a remnant that took refuge in the woods now remains.

So it has been or will be of every large animal that lives in the open. The mice and shrews may survive in the grasses of the marsh. That to them is a forest and offers them the same protection. The badgers and gophers take refuge underground; but no animal can live on the open plain without some form of shelter.

The shelter which all animals need is supplied by the forest. Under the protecting canopy of the trees is a world teeming with life. You only need to sit down hidden by some sheltering bough and watch. With such a stage spread before you the drama will go on. First the squirrels will appear. They are the most restless and most fearless. They scamper here and there in open day because their greatest enemies hunt by night. Then the wood mice come, timid, secretive and silent, yet each busy with his affairs and intensely interested in the simple matters which make up his life. No act is trivial which helps a living being to get its food or shelter or to provide for the rearing of its young. Next comes a hare in hot haste, closely followed by a red fox; or perhaps a red deer comes close enough to scent you, and you see his white flag and hear the *tip tip* as his feet lightly touch the ground — no other sound though he threads his way through a maze of brush.

So the stream of life goes on beneath the covering of trees and night brings no cessation. Other actors appear. More of tragedy is enacted as the lynx and the gray wolf go out to kill, that they and theirs may live. But all alike depend upon, and are screened and sheltered by the forest roof. Scenes of bloody murder or deadly conflict

are relieved by touches of the tenderest and purest of all passions, that mother love which softens and ennobles the life of all the higher animals. But over and around all is the forest which shelters this life and makes it possible.

The birds, too, play their part. The ruffed grouse twits and struts and drums; the blue jay, fresh from pilfering some nest, screams out his satisfaction with himself, while on some high stub the cock of the woods pounds monotonously as he extracts the juicy grubs. The glossy black of his back makes a beautiful contrast to the fiery red on his head, yet his is no holiday attire. He is an industrious woodsman and has his living to make. The little birds, too, warblers, nuthatches, chickadees and creepers, keep up their search for insects, each in its own way and in its own place. No one intrudes on the domain of the other. They all go about their work with an earnestness that shows how serious is the struggle to live. In fact the tree tops as well as the ground beneath throb with life, which they enfold with a security that enables each living thing to do its work in comparative safety. The woods has made these creatures what they are, has shaped their habits and sharpened their senses, and the woods protects and provides for them. And it is not only the winged or the four-footed that the forest has nurtured. What is true of bird and beast is true also of mankind.

The forest has had tremendous influence upon the life of man. In earliest times it supplied his fuel and shelter. His rude tools and weapons were shaped from its roots and stems, while nuts and berries were his surest supply of

food. Later, it furnished the material for the house in which he lived, the carriage in which he rode, the bridges with which he spanned the rivers and the ships in which he sailed the seven seas. The sun at noonday filtered through the leaves of the trees which sheltered his dwelling. The winds which blew over his fields were tempered by the adjoining wood lot, and the water in the springs was conserved for his use by the woods on the hillsides.

When North America was discovered, its whole eastern coast presented an unbroken forest which extended westward past the Great Lakes. The work of the early settlers was a continual struggle against this forest. The cultivation of the land was slow and difficult because the trees had first to be cleared away. Communication between the scattered settlements was hindered because the way was often blocked by fallen trunks.

Two generations spent their lives in toil before the eastern provinces of Canada were reclaimed. The struggle was so severe and long that it left an indelible impress on the people. Much of the sturdy independence of Canadians is the result. Men who had contended single-handed against all the forces of nature did not submit lightly to restrictions of any kind, much less to oppression. The free and vigorous life of the forest found expression in political and religious freedom.

The economic life of the people was also affected. Where each family was forced to rely almost entirely upon the efforts of its own members for food, clothing and shelter, there must be saving. It was not merely a virtue but a

necessity, where waste meant starvation. Industry, resourcefulness and thrift were necessary in this struggle for existence, and we are once more learning that these primitive

Courtesy Forestry Branch, Interior Dept.

FIG. 1. — Jack Pine Forest, in Peace River District.

virtues make for permanence in a nation. We are beginning to realize the value of the moral inheritance handed down to us by those hardy pioneers.

In the intellectual life the influence of the forest was also evident. Its magnitude and mystery stimulated the imagination. The hardships it imposed made education hard to get and highly prized. Out of these conditions arose a set of men seldom equalled for vigor of mind and firmness of will; clergymen and lawyers who kept frontier conditions from meaning lawlessness and irreligion, and statesmen who welded a few scattered settlements into the

foundation of a great nation. If we feel at times that they were wasteful of the gifts of nature, let us remember the conditions under which they lived; that their continuous struggle against the forest made it seem to them a natural enemy.

If we are to have a different sentiment, we must create it in the children. The attitude of the rising generation toward the forest is not one of antagonism but of indifference. They have not had to fight it and so do not regard it as an enemy; not knowing its value they do not see in it a friend. The responsibility rests on the schools to develop in the young a proper appreciation of our forest heritage.

CHAPTER II

THE VALUE OF FORESTS

"When I go to the woods, it is like going among old and treasured friends, and with riper acquaintance the trees come to take on, curiously, a kind of personality, so that I am much fonder of some trees than of others, and instinctively seek out the companionship of certain trees in certain moods, as one will his friends."

—David Grayson.

When considering the value of the forest to man, one naturally thinks first of those things about him which are made of wood. This does not mean that we fail to recognize that our wooded tracts have other values, but simply that these are the things we are apt to think of first. We know that our houses, our furniture, our machinery, our vehicles, and many other things are at least partly wooden. In a more or less hazy way we admit that to have a supply of wood we must have forests. Most people stop thinking there. They have nothing with which to think. The mind which is the organ of thought may not fail them, but knowledge, which furnishes the material for thought, is lacking. Anyway, why should we worry? Have not the politician and the immigration agent assured us time and again that our forest resources are inexhaustible? There is clearly, if this be true, little need to inquire exactly the value of what the forest furnishes us, so long as we are sure its products will always be forthcoming.

Of late we have not felt so secure. A general rise of

prices has an unpleasant suggestion of failing supply. Rumors of exhausted timber limits and the sight of miles on miles of treeless waste where once were magnificent forests have tended to lessen our sense of security, and

Courtesy Forestry Branch, Interior Dept.

FIG. 2. — Douglas Fir Timbers for Use in Toronto, Ont., Harbor Construction.

many are now wondering whether we have not over-estimated our supply of timber, and whether or not we are taking proper care of what remains.

To reckon the value of anything, we may estimate either the service it renders or its price in money. The former is not an easy thing to do, as we have no common standard of service. Without attempting to be exact, let us try to feel the measure of satisfaction we get from things made of wood. Let us imagine, if we can, what our condition would be if suddenly all wood ceased to exist; if all wood and things made from wood, without the agency of fire or decay, should suddenly vanish. On this continent a very

large proportion of our buildings would disappear; many of those that did not would be shapeless masses of ruins; while those that still remained standing would lack all inside furnishings. Not only would our dwellings and places of business be either gone or made useless, but also the furniture they contained. Much of our machinery and most of our vehicles would be in the same condition. All manufacture would be stopped for lack of buildings or material; the railways would be shifting lines of steel, and most of the cars but grinning skeletons. The picture might be enlarged by the addition of endless details, which would show all production and communication stopped, and the race face to face with hardships that cannot be imagined. In fact we should be threatened with death, before arrangements could be made which would enable us to live without wood. Even if such arrangements could be made and man continued to exist, many of our accumulated treasures of art and literature would have disappeared with the books and paper made from pulpwood cut in our northern forests.

To some, this will appear a fanciful way of computing value. Facts without figures do not appeal to everyone. The following extract from the report of the Director of Forestry for 1913 furnishes some convincing figures as to the amount of timber; the area referred to is in the vicinity of Lesser Slave Lake.

"The area examined was some 7330 square miles, and a large proportion of this is rough, broken land at a considerable elevation, forming the watershed between the

Athabaska and Peace River valleys. South of the Athabaska River and west of the McLeod River the land is generally low-lying and of good quality, and again to the north around Grouard, Sturgeon Lake, and Grande Prairie; but between these two tracts intrudes the area of elevated, broken, and poor land described.

"A résumé of the area examined is as follows:

	Sq. Miles	M Ft. B.M.	Cords
Mature spruce and pine . . .	364	2,839,460	
Mature poplar	1362		17,336,000
Young forest (up to 100 years old) of spruce and pine with poplar and birch intermingled	1500	2,672,680	2,675,600
Forest of pole size, 35 to 75 years old.	2060		
Young reproduction, spruce, pine, poplar, birch	1408		
Brûlé, lately burned	740		
Total	7434	5,512,140	20,011,600

"The timber on this tract is lodgepole pine, spruce, balsam fir, tamarack, poplar, and white birch. There are very few areas of mature timber, owing to recurrent fires. Probably eleven per cent of the area has been burned over in the last twenty years. As a rough estimate, Mr. Doucet has calculated that the area examined carries 20,009,600 cords of poplar and birch, of which seventeen millions are poplar. The mature spruce and pine timber covers an area of approximately 364 square miles, with a production estimated at 2,839,460,000 feet, board measure. A young forest of spruce and pine well on to maturity covers an area of 1500 square miles, and has a stand of 2,672,680,000

feet, board measure, of these species, with some 2,675,000 cords of poplar and birch intermingled. A still younger forest of spruce, pine, poplar, and birch covers an area of 2060 square miles. This younger forest, if properly protected from fire, will mean an immense source of wealth."

If we were to multiply the quantity of timber on the area surveyed by the number of times the whole forest area is greater than that, we might get some conception of our forest wealth. Even then it would not take into account the fact that the area surveyed is a rather poor forest, that a large part of it is covered by young trees that have not reached marketable size, and that they are not the kinds producing the most valuable timber. In British Columbia there are forests producing many times as much timber to the square mile and the timber of a more valuable kind.

An estimate of the total value of the different classes of forest products is given below. The figures are rounded to hundreds of thousands and form as reliable a summary as possible with the data available.

Lumber, lath, and shingles	$84,000,000
Firewood	50,000,000
Pulpwood	12,000,000
Posts and rails	10,000,000
Cross-ties	8,000,000
Square timber exported	1,900,000
Cooperage	1,700,000
Logs exported	1,100,000
Poles	1,200,000
Tanning material	1,000,000
Round mining timber	600,000
Miscellaneous exports	300,000
Miscellaneous products	10,500,000
Total	$172,300,000

The following diagrams taken from the reports of the Forestry Branch are interesting.

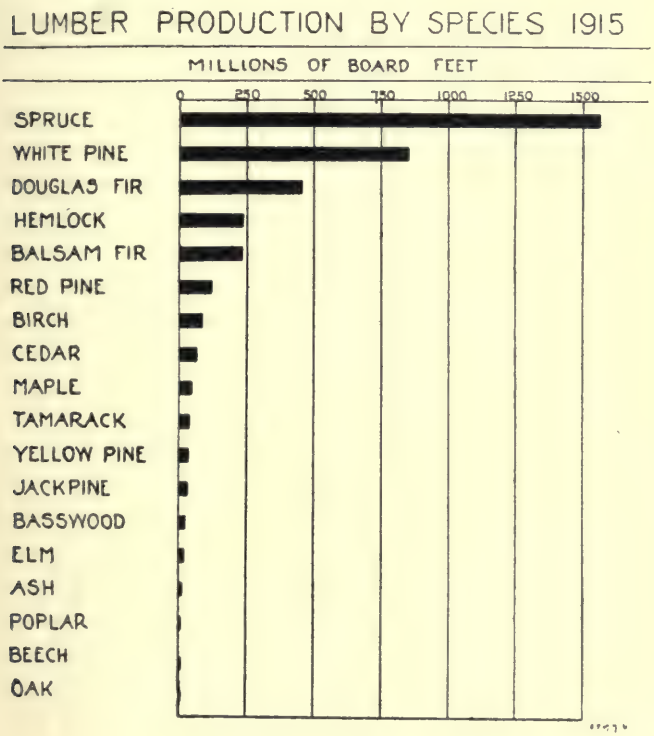


FIG. 3.

These diagrams refer only to sawn timber, leaving out of consideration timber used for fuel, pulpwood, poles or for other purposes. The fact that the output is on the decrease indicates that the supply is failing.

"Canada cut in 1915 a total of 3,842,676,000 feet, board

measure, of lumber valued at $61,919,806. The production decreased 2.6 per cent from that of 1914 and 12.4 per cent from that of 1912, the year for which the greatest cut was

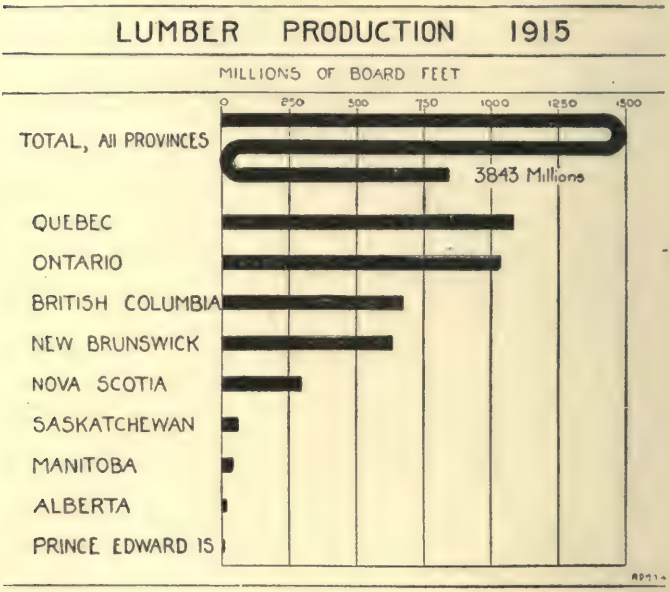


FIG. 4.

reported. The provinces of Quebec, Ontario, Manitoba, Alberta, and British Columbia show a decrease in cut in 1915 as compared with 1914. British Columbia had the greatest falling off (28.5 per cent from that of 1914), New Brunswick shows the remarkable increase of 52.7 per cent over the cut of last year." This was probably due to an increased demand for timber on account of the World War.

While it is no doubt true that the supply of material is the most apparent good we get from the forest, it is likewise true that there are certain other values which are also very important. One of these, which very frequently escapes our notice, is the effect which it has on preserving and equalizing the moisture. Our rivers take their rise in hilly or marshy regions, generally where the snowfall is somewhat heavy. If this snow melts rapidly in the spring, before the frost is out of the ground, the streams become flooded, sometimes to the point of doing damage; and the water supply caused by the melting snow which should, if properly conserved, help to supply moisture during the summer, very quickly runs off. If, however, the region surrounding the sources of the streams is well wooded, the case will be different. Very often the snowfall will prevent the ground from being frozen to any great depth. In the spring this snow remains longer than it would without the protection of the trees. While it is slowly melting, the ground beneath it thaws and the water gradually soaks into the soil. Only the surplus, after the ground has been thoroughly saturated, is drained off in the spring freshet. This water, supplied by the melting snow, raises the general water level in the ground over the whole district and gradually seeps out during the summer in springs, making the supply in wells and streams more uniform during the season. The level of the water in the soil being raised, it is easier for moisture to reach the roots of the plants from beneath.

Observations in Europe have shown that, of the rain

which falls on a forest, 10½ per cent evaporates, 20 per cent is stopped by the foliage of the trees, 25 per cent is absorbed by the layer of decayed leaves forming the forest floor, and 44 per cent soaks into the soil. Of the rain falling on the open ground, 68½ per cent evaporates and 31½ per cent is absorbed by the soil. The effect on the whole country of this preservation of water is greater than people imagine, and it can be estimated only by considering the results in places where the forest has been cleared away from the sources of the streams. In the eastern provinces there were many rivers that supplied water to run mills and factories through the whole summer. These rivers, too, were not subject to floods in the spring. As the forests surrounding their sources were gradually cleared away, two results were soon apparent. The rivers became flood streams in the spring freshets, even flooding towns on their banks and carrying away bridges and buildings. Then, too, the water began to fail in the summer, and factories, which had formerly been run by water power, now have to depend on steam through a good part of the year. This effect has been visible wherever a river basin has been largely cleared.

The late Mr. Cecil B. Smith, C. E., formerly chairman of the Timiskaming Railway Commission, says that many rivers in southwestern Ontario, including the Thames, Grand, Credit and Humber, all at one time possessed valuable water powers, but that when their basins were cleared of forests these water powers were all ruined.

Mr. W. H. Brethwait, C. E., says that the minimum flow

of the Grand River decreased 40 per cent during the five years from 1890 to 1895, and that this decrease was due to the clearing of the land about its sources.

Mr. C. H. Keefer, C. E., says the spring floods of the Ottawa River reach the city of Ottawa two weeks earlier than formerly, owing to the clearing of the drainage basin.

In the western provinces the effect has not yet been apparent, because some of them are largely prairie and in other places the timber has not been entirely removed. The Assiniboine River rises in the wooded districts of the Duck and Riding Mountains, and the depletion of timber in these regions has had a marked effect on both flood conditions in the spring and the flow of water during the summer. The Saskatchewan has its source in streams rising along the east side of the Rocky Mountains. If this region became treeless so that the snow on the eastern slope of the mountains and their foothills melted suddenly and rushed into these rivers, the effect in floods might be disastrous. The more steady flow in rivers during the summer, when the water is retained in the wooded slopes of the mountains, helps to keep the water level in the soil nearer the surface all summer, and the effect of this on growing crops would be hard to estimate. In the mountain regions the danger from the too great denuding of the slopes would be quite as apparent, although there is not the same likelihood of its being done.

Still another value which comes from the forest is the protection which it affords against storms in summer and cold winds in winter. This is particularly true of the

prairie region where protection is so necessary, and where it can be obtained only by the growth of artificial plantations. It has been shown by actual measurement on the Experimental Farm at Indian Head, that a row of trees will protect a standing crop against the most violent storm for a distance of fifty feet per foot in height of the trees. That would mean that a growth of trees fifty feet high would afford protection for 2500 feet, or approximately half a mile. Thus a row of trees of that height would to a greater or less extent protect a quarter section of land. When the damage done by violent wind storms has been more accurately measured and estimated, the value which we might secure from forest protection will be the better understood and appreciated. The need of protection for buildings in the winter is very obvious and the value of trees for that purpose need not here be dwelt upon.

The effect of forests upon climate is somewhat doubtful. There is no doubt a relation between the amount of rainfall and the nature and extent of forests, but it is not always clear which is cause and which is effect. It seems reasonable to suppose that while the rainfall may have originally helped to cause the forest, the forest may, by helping to condense the moisture of the atmosphere, increase the rainfall.

The protection of game, while a less important item, is still of considerable value, both economic and scientific. The bison of the plain has disappeared, as has almost every other large animal that lives in the open. The moose, elk and caribou, protected by the forests, still remain.

Closely related to this is the protection of bird life. The value of birds as a factor in the control of insects is difficult to estimate and is often overlooked, while the more subtle service they render by their cheerfulness and their music can never be measured by human standards. Yet without the woods we have few birds. The birds and the woods have lived together, and if either is destroyed they may vanish together.

There is a very direct relation between the timber supply of a country and the life of the people. Perhaps no one factor contributes more to the higher standard of living in North America compared with Europe than the plentiful supply of wood. Plenty of wood means cheap building material. The cheap wooden building is only temporary, and, as the condition of man improves, it is removed to make place for a better and more permanent one. Thus the log shanty of the pioneer gave place to the frame house of the prosperous settler. This in turn is being replaced by the modern, sanitary and convenient home of brick and concrete. The knowledge, experience and resources of three centuries were available before houses were built which could not be readily changed. This prevented poor living conditions being made permanent in brick and stone, and change from being, if not impossible, at least very difficult. Change in the character of buildings marks the difference between a growing and a settled society. If it is true that in a society where conditions are stationary, the type of buildings remains unchanged, there is also truth in the opposite statement, that if the buildings are of a

character that cannot be easily improved, this reacts on all living conditions and tends to make them permanent.

There is a value in trees and forests that can never be measured in terms of money, moisture, or protection from winds, — that subtle beauty which marks a varied landscape that clings to the home nestling among trees. This is the beauty and the charm which binds people to the soil, and the lack of which sends many young people to seek more congenial surroundings. Let us not underestimate the value of the forest in making any region beautiful, for this value is none the less real because it is spiritual rather than material.

CHAPTER III

FOREST DEVASTATION

"Behold how great a matter a little fire kindleth."
— EPISTLE OF JAMES.

LET us understand clearly at the outset just what is meant by devastation of the forest. There is a sort of weak sentimentalism which laments the destruction of any tree, no matter how well matured or what the purpose to which the timber is applied. This foolish feeling is not what the real forester is trying to develop, nor is it that which will gain the respect of the general public. There is too frequently, however, a purely wanton destruction for purposes in themselves not worthy, a using of partly grown trees, which if left would be much more useful at another time; or more often a careless or thoughtless destruction for no purpose whatever, a sheer waste of timber. This useless destruction of forests is what we mean by devastation.

No person need regret the felling of a full-grown tree, when the timber is properly used. A tree, like any other plant, grows, matures and declines. Some mature in a few years and some take centuries, but once they mature they should be used or they will decay. In the same way we need not deplore the clearing away of forests, if the land is to be

used for other purposes and is suitable for those purposes. Good farm land is not producing at its best when left in forest. The best thing to do with it is to remove the forests and devote it to a more fruitful purpose. Of course the timber should not be wasted, if waste can be avoided. In the early settlement of Canada it was impossible to clear the land and not waste the timber. There was so much forest, that no market could be found except a very limited one near the sea coast. The destruction of magnificent forests for the purpose of securing land could not then be avoided and need not now be deplored.

There is a present danger, however, which comes as a result of the early struggle with the woods. The removal of the trees to make room for field crops was such a serious matter that a tree came to be looked upon as the natural enemy of man. Trees were so plentiful that their presence was taken for granted and their value simply overlooked. Clearing was so slow and laborious that for a time it was the chief work of the settler, and any means he could employ he thought lawful. There is no doubt that an almost total disregard of the value of the forest and a tendency to destroy it or permit its destruction are legacies which the present generation has received from pioneer days.

Our inexhaustible forest resources once formed a favorite subject with speakers and writers, who thought more of a high-sounding phrase than of truth. We now face the facts and realize that our forests are not only not inexhaustible, but are within a measurable distance of being exhausted, and that if the rate of devastation should con-

tinue to be as rapid as it has been, serious lack of most useful material will result.

One of the most universal, if not the most destructive forms of forest devastation is the clearing of land which is not suitable for anything but the growing of trees. Canada has vast areas which can never be good farm lands. In many places these have been opened to settlement, and the settlers, after taking a crop or two and thus exhausting the fertility laid up by nature within a few inches of the surface, have found crop growing unprofitable or impossible. The abandoned farms of the New England States, and of some parts of the eastern provinces of Canada, have passed through this history. The western provinces have not suffered so much, but even on the prairies we sometimes see stretches of drifting sand being plowed up, which will not only prove unprofitable but will also be a menace to the surrounding districts.

Besides whole areas unsuitable for cultivation, almost every farm has some land that would be of most good left in forest. River valleys, hillsides and rough, rocky or wet places are often not only useless but unsightly, or sources from which the well-cultivated land gets a perpetual supply of weeds. These places should either be left wooded or else planted with trees, so that they could protect the better parts from wind, form a permanent source of timber for fuel or other purposes, and at the same time beautify the surroundings. Every farmer, by planting these waste places, will do his part in restoring the balance between cultivated land and forest.

Wasteful methods of cutting timber often serve to destroy the remaining trees. When wood was very plentiful and correspondingly cheap, it was hardly possible to require lumbermen to pile and burn all the refuse. Even trimming off all branches so that they would fall on the ground, thus hastening their decay and lessening the chances of fire, was considered too expensive. It is time now so to regulate the quantity of timber cut that a sufficient price will be paid for it to make proper methods of cutting possible.

Destructive methods of clearing, careless selection of land to be cleared and wasteful methods of cutting, all belonged to the time when our timber was thought to be inexhaustible, and any means was permissible which could make open spaces in the apparently endless woods. The means most often used, and which proved effective beyond the wish of the most destructive mind, was fire. The harm done to the forest by all other means combined is as nothing in comparison. In fact, it is only by invoking the aid of fire that man can overcome the forest. Its natural growth would more than replace all he could use or destroy, did not fire and disease follow in his wake.

Few things may be more commonplace or more terrible than a forest fire. In any wooded district, where land is being cleared for cropping and the setting of fires is not regulated by law, small fires may be seen around the edge of almost every clearing. These have been set to clear off brush piles and other refuse, and have been allowed to escape to the neighboring woods. Often the settler is

anxious to have the adjacent woods burned to assist in clearing the next year. These small fires usually do no more harm than to kill a number of trees and leave a dangerous slash about the clearing. They generally die out of their own accord and are seldom spectacular. Some smouldering logs, a little flame here and there creeping along the dead leaves, or the occasional blaze when a pile of dead brush or a clump of balsam trees is reached; that is all. If it shows a tendency to spread too much, especially if it threatens to burn fences, the farmer resorts to a little fire fighting. The leaves are scraped away in a track across its front; all rotten logs that could carry the fire across this cleared strip are dug out and the brush is piled back. Sometimes a little water is carried to extinguish smouldering logs, or the spreading ground blaze has to be beaten out with brush or old sacks soaked in water. The whole process is uninspiring, seldom exciting and always dirty. A shower comes and fires are forgotten. The very frequency of these small, and usually considered harmless, fires tends to make the settlers careless. It is doubtful, however, if the total harm done by them is not more than that done by the large ones which are often tragic. Certainly without the small fires there would be no large ones.

Sometimes there is a summer when the shower does not come. Day after day the sun shines hotter and the earth becomes drier. Every bit of brush is dry and snaps under foot; every rotten log is but a heap of tinder; in the pine woods, where the sun reaches the ground, the needles are parched and give way under the foot like dry sand. The

very moss, instead of forming a soft cushion, becomes a dry prickly crust, which grinds audibly to powder under foot. The small harmless fires show a perverse tendency to run. The settler often has to leave his work to fight a running ground fire, or sometimes go to the assistance of a neighbor. The air becomes blue and hazy; the sun sets as a dull yellow ball through the haze, and the smell of burning wood pervades everything. The time is now ripe for a big fire, and with dry weather it will come. No one knows just what or whose fire "got away." The small fires join forces, the wind rises and suddenly the settlers are aware that the whole forest is ablaze. The smoke often obscures the sun and turns day into a thick twilight. If the settlement is in the pine woods there is almost no limit to the harm that may follow. Instead of running along the ground the fire now becomes a "crown fire." It travels from tree to tree, and burning branches are carried by the wind across any narrow openings in its track. Usually it does not travel rapidly, but it is irresistible in its onward sweep. No gentle means of fire fighting will now stop it. It goes until it burns itself out, that is, it dies down for lack of suitable fuel.

What adds strength to the fury of these fires is the brush left by the lumberman. A single cutting does not remove a large percentage of the trees, but it leaves brush enough to carry the fire. The first burning kills a great many of the remaining trees, which in time fall down, dry out and form ideal conditions for the next. This second fire kills practically all the remaining trees, and after a third there

is little left of the original forest. It is then ready to be resown by birch and poplar, and the slow process of forest formation begins afresh.

The one thing that will stop a big fire in a dry summer is green hardwood. The broad-leaved trees form a much denser shade and the ground does not become so dry. The leaves themselves are not resinous and do not readily burn while green, and the undergrowth does not allow the breeze to blow as freely as in the more open "pinery." Fire will run in the hardwood in early spring before the leaves are out on the trees, but is easily stopped and usually does little harm.

Some of the historic fires of this continent may be mentioned to show the damage which may be done, but it is well to remember that so far as destruction of property goes the small fires have done many times as much harm.

The worst fire in the history of the continent was what is known as the Peshtigo fire, around Green Bay, Wisconsin. It destroyed more than $3,000,000 worth of property, left more than 2000 families homeless and cost some 1500 human lives. This fire occurred in October, 1871, the same month and year as the great Chicago fire.

The next greatest fire, so far as loss of life is concerned, but not for property loss, was the Hinckley fire in 1894. This was in Minnesota, southwest of Duluth. Some 418 persons lost their lives, 233 of them belonging to the village of Hinckley.

In 1881, the great Michigan fires about Saginaw, in Huron and Sanilac counties, swept about 1800 square

miles clear of trees, crops, buildings, bridges and fences. The property loss, not counting the timber and injury to the soil, was more than $2,000,000. One hundred and thirty-eight persons perished.

The Porcupine fire in northern Ontario in 1911 cost 84 lives and property loss which has not been estimated, while

Courtesy Forestry Branch, Interior Dept.

FIG. 5. — Burned-over Tract in Mountainous Territory, British Columbia.

the "clay belt" fire in 1916 caused the loss of probably not less than 250 lives and the destruction of several million dollars' worth of property, and the Minnesota fire of 1918 caused an immense destruction of property, while the loss of life has been estimated at between five hundred and one thousand.

Great as these losses have been in both life and property, nothing has ever happened in bush fires that is not capable of being repeated in the spruce woods of northern Manitoba,

Saskatchewan and Alberta, or the fir forests of British Columbia. There are no hardwood stretches in these places to check a fire, and a repetition of the same carelessness will produce the same results.

To show how small is the destructive work of man compared with that of fire, we quote the following from a bulletin issued by the Director of Forestry.

"According to the Dominion Census of 1901 there were 98,804 square miles of occupied land in Canada at that date. This has been since increased to approximately 110,000 square miles. Of this total, 18,000 square miles is located in the prairie, thus leaving 92,000 square miles of land within the forested area, which have been cleared for settlement. Although 25,000 square miles of this is reported as still wooded, in order to be conservative we shall not consider it as an addition to the forested area.

"The total area cut over by lumbermen in the past, outside of the area cleared for settlement, can only be approximated. If it is granted that the lumbermen have cut over 100,000 square miles of land, exclusive of lands occupied for agriculture or settlement, it would mean a total cut in the past 300 years of 192,000,000,000 board feet, at the low yield of 3000 board feet per acre. This, in addition to the large quantity which has been cut from the 92,000 square miles of cleared farming lands, is certainly as much lumber as has been produced in Canada. Therefore, it may be assumed that lumbermen in Canada have not actually cut more than 100,000 square miles of green timber, if indeed they have cut as much, when allowance is made for the area covered by fires which have caused their operations to be scattered.

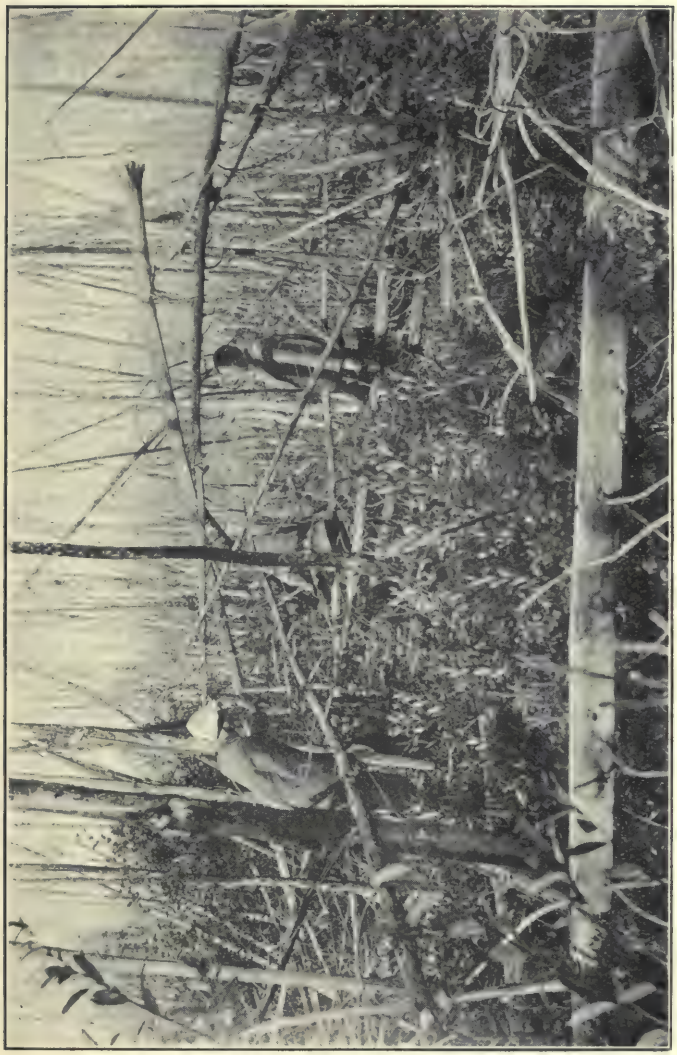
"The original timbered area, omitting semi-treeless land, was approximately 1,900,000 square miles. Of this we have

shown 98,000 square miles to have been cleared for settlement and 100,000 square miles to have been cut over by lumbermen, leaving a timbered area yet untouched of 1,702,000 square miles. Assuming the average of 3000 square feet per acre there should yet remain 3279 billion board feet of timber in Canada at a very conservative estimate. On the contrary the highest estimate which has been made, that given by the Chairman of the Conservation Commission, the Honorable Clifford Sifton, places the amount of saw-timber and pulpwood in Canada at 494,600 million feet and 1100 million cords respectively."

By converting the pulpwood into board feet, allowing 500 feet board measure for each cord, "it is found that there are standing in Canada only 1094 billion feet of lumber, including the very low grades. The difference between this and the quantity which should yet remain is 2185 billion feet." This quantity has been destroyed by forest fires.

"It is a quantity so large as to be beyond comprehension; it is 437 times as much as is yearly cut in Canada; it is 49 times as much as the combined yearly cut of the North American Continent, north of Mexico. It means that for every foot of timber that has ever been cut in Canada by lumbermen, at least seven feet have been destroyed by fire. If the stumpage value is placed at the low sum of fifty cents per thousand feet (the smallest royalty collected by any Canadian Government), the loss to the public treasury has been $1,042,500,000. The actual money loss to the country has been many times greater, as several dollars are expended in logging, manufacturing, and shipping every thousand feet of lumber."

The figures given refer to the whole of Canada, and it might be reasonably expected that its application would be mostly to the older provinces. To those who have crossed



Courtesy Forestry Branch, Interior Dept.

FIG. 6. — Brûlé, or Burned Area, in a Manitoba Forest.

through the stretches of burned pine forests in all four of the mainland provinces east of Manitoba, it would seem that surely here were barren hills and blackened stumps enough to account for any array of figures, no matter how stupendous. The western provinces, however, have had their share of fires. Hear what the explorers say:

"Ninety per cent of the Riding Mountain forest reserve (total area 982,400 acres) has been burned over." J. R. Dickson, 1908.

"The northern face of the Duck Mountains has formerly supported much excellent forest, but most of this area has now been burned over and is being overgrown with poplar." J. B. Tyrrell, Geological Survey, 1887.

"Seventy-five per cent of the Beaver Hills forest reserve, and recommended inclusion (total area 108 square miles) has been burned over."

"Forest fires have repeatedly overrun the Prince Albert forest reserve, and recommended addition, of 214 square miles."

"In the Crowsnest Valley, Alberta, out of a total of 212 square miles originally timbered, 179 square miles or 84 per cent have been burned over."

"The resources of the eastern slope of the Rockies as represented by timber have been reduced 75 per cent by forest fires." H. R. Macmillan, Forestry Branch Report, 1908.

"Fires have passed extensively over the country between Quesnel and Blackwater, destroying the scrub pine and Douglas fir. It is evident that the destruction of the forest has led to the desiccation of the soil." G. M. Dawson, Geological Survey, 1876–1877.

The list might be extended indefinitely, each item referring to a definite place, large in itself but small

compared with the whole timbered region of the four provinces.

In 1909, the forest rangers over the whole region from Lake Winnipeg to the Athabaska River, the eastern slope of the Rocky Mountains and the railway belt in British Columbia, were asked to ascertain and report the percentage of each district which had been burned over within forty years. Replies were received from sixty-nine rangers whose ranges lie mostly beyond the limits of railways and settlements. The following results, with comments, are taken from the report:

"Area reported on	203,300 square miles
Area of merchantable timber	34,484 square miles
Area burned over within 40 years . . .	54,700 square miles

"The whole territory of 203,300 square miles bears abundant evidence of having been originally heavily forested, excepting for the small proportion occupied by muskegs, lakes, and waterways. But within the past one hundred years, fires have wrought such havoc that now only about 17 per cent or 34,484 square miles are reported to be covered with the original stand of merchantable timber."

Such examples as to the prevalence and injury of fires might be multiplied many times. One stops, not for lack of evidence, but from the feeling that a case has been established; that to go further would be to dwell needlessly upon what is quite clear.

Fires do not come as a judgment from heaven. They are the result of the carelessness of man, and the causes need to be known if the results are to be prevented. Every fire

has usually two causes, one immediate, the other more remote. If a great amount of inflammable material be left where fire can reach it, the whole blame for the resulting disaster does not rest on the person who applied the necessary spark, whether thoughtlessly or with design. A sun-parched pine forest often burns, but usually the fire has gathered force in the brush left from previous cuttings. Lumbermen seldom start fires directly, but, by leaving the brush of the winter's cutting on the ground, they have provided the material for almost all of the great fires and many of the lesser ones. Until means have been found to secure the proper piling and burning of the brush left when timber is cut, there can be no adequate protection of the standing trees. The securing of this must be the first step in any system of forest protection.

Of all the direct causes of fire the most common is the burning brush pile in the new clearing. This gets out of control, reaches the slash left by the lumbermen, and only the amount and condition of the available material sets the limit on the conflagration that may follow. One fire provides fuel for the next, and the chain of destruction is only complete when the whole forest is consumed.

Railways have also been accountable for many fires. The first danger arises from those set to clear the right of way when the roads are being built. This danger is the same as, and may be considered a part of, the general menace of fires set for clearing land. It passes when the road is completed, but the likelihood of fire from sparks from the locomotive is fairly constant.

If the regulation for the control of fire in the clearing of the right of way by the Transcontinental Railway Commission were generally enforced, the danger would be reduced to a minimum. The regulation is as follows:

"The whole, or as much of the right of way as the engineer may direct, shall be entirely cleared of all trees, logs, brush, and other perishable matter, all of which shall be burnt or otherwise disposed of as the engineer may direct, unless specially reserved to be made into timber, ties, or cordwood. Unless directed in writing by the engineer, trees and brush must not be thrown on adjacent lands, but must be disposed of on the right of way. Trees unavoidably falling outside the right of way must be cut up, removed to the right of way and disposed of."

The enforcement of such a regulation is difficult and requires special patrol officers, but on the Grand Trunk Pacific, through Dominion lands west of Edmonton, it was enforced, and there were not forty acres burned outside the right of way.

The danger from sparks from the locomotive is also being met by regulations covering the construction of the engines. This is not easy, as mechanical difficulties are in the way, but these are being overcome. All engines are required to be equipped with spark arresters, and the regulations of the Dominion Railway Commission require that the locomotive shall be inspected once a month by an official of the company. The Commission also employs a force of inspectors for this purpose, but not enough to make inspection prompt and adequate. Authority has also been

given to some of the permanent forest rangers to inspect the engines. All this, however, while it lessens the danger, has not entirely removed it.

As a further provision, the Railway Act of the Dominion contains the following clause:

"The company shall at all times maintain and keep its right of way free from dead or dry grass, weeds, and other unnecessary combustible matter."

The railway company is also made liable for damages arising from fires caused by its engines by the following clause:

"Whenever damage is caused to crops, lands, fences, plantations, or buildings and their contents by a fire started by a railway locomotive, the company making use of such locomotive, whether guilty of negligence or not, shall be liable for such damage and may be sued for the recovery of the amount of such damage in any court of competent jurisdiction; provided that if it be shown that the company has used modern and efficient appliances and has not otherwise been guilty of any negligence the total amount of compensation recoverable in respect of any one or more claims for damage from a fire or fires started by the same locomotive and upon the same occasion shall not exceed five thousand dollars."

The unguarded camp fire is another peril, but men who live in the woods are usually careful. They know the dangers and how to avoid them. It is the novice who leaves his camp in the morning with the fire smouldering and returns to find his belongings in ashes and the hillside in flames.

Lightning may cause a forest fire but seldom does. A thunder storm is usually accompanied by a drenching rain which lessens the danger. I have seen many forest

fires, but only once saw a tree shattered by lightning and left smouldering after the storm had passed. It is more than likely that many of the fires attributed to lightning were really caused by other means. The fact that fires follow in the wake of man is sufficient indication that he is the cause, they the result.

Spontaneous combustion is not impossible, but is so rare that it need not be seriously regarded as the cause of many fires.

The following report of the Dominion Forestry Branch shows the origin of fires reported during 1916:

"The number of fires reported in detail during the year was 1455, of which 1112 were small fires, and 343 large fires, covering over ten acres each. The total area burned over was 905,828 acres and the quantity of timber destroyed 223,908,000 feet, board measure, and of smaller-sized trees 2,415,921 cords. These totals do not include fires along the Hudson Bay Railway line or fires in the most northern parts of Manitoba, Saskatchewan, and Alberta in regard to which detailed reports were not received."

The causes of fires were as follows:

	Number of Fires	Percentage
"Railways	123	8.46
Saw-mills and logging	34	2.33
Brush burning (other than by settlers)	10	0.68
Settlers	246	16.90
Campers and travellers	410	28.18
Incendiary	14	.97
Lightning	60	4.13
Other causes	30	2.07
Unknown causes	528	36.28"

The noteworthy feature of this report is that more fires were caused by campers and travellers than by settlers. An explanation of this is, no doubt, found in the fact that in the area on which reports were received, regulations covering the setting of fires are enforced, thus reducing the number caused by settlers. It must also be remembered that in this region the number of campers is very large.

The following is a summary of the laws respecting fire in the four western provinces.

Important Points in the Forest Laws

The Canadian Criminal Code provides that any person who wilfully sets fire to timber or timberland is guilty of an indictable offence and liable to fourteen years imprisonment; and any person who wilfully attempts to set fire to timber or timberland is liable to imprisonment for seven years.

The Criminal Code also provides that any one who carelessly or in violation of a municipal or provincial law sets fire to timber or timberland is guilty of an indictable offence and is liable to two years imprisonment.

Extracts from the Laws of Manitoba

The Fires Prevention Act, Chapter 35, 1917

2. (*c*) "Wooded District" in this Act means and includes the following described territory, all lands lying east of the west boundary of range 9, east of the principal meridian, lands lying east of Lake Winnipeg, and north of the south boundary of township 16, lands between Lake Winnipeg and Lakes Manitoba and Winnipegosis and north of the south boundary of township 25, lands west of Lake Winnipegosis and east of the Prince Albert line of the Canadian Northern Railway and north of the south boundary of township 32, and all lands to the north of the districts indicated, except the Rural Municipalities of Swan River and Minitonas.

3. If found necessary the Lieutenant-Governor-in-Council may, by proclamation, declare any part of the Province to be a "wooded district" within the meaning of this Act.

7. Any person who shall kindle and leave a fire burning, without taking effectual means to prevent its spreading in or on any woods, prairies, meadows, marshes or other open grounds, not his own property, or who, intentionally or by gross carelessness, permits any such fire to pass from his own land to the injury of the property of any other person, shall, on conviction therefor, be fined in a sum not exceeding $100, nor less than $20, and, in default of payment thereof, shall be imprisoned for a term not exceeding six months.

9. (Synopsis). Any person shall be permitted to start a fire for cooking, warmth or other industrial purpose, but before doing so shall select a spot where there is the least amount of combustible material and the least danger of the fire spreading, and shall clear the ground of brushwood, leaves, and other inflammable matter for a radius of ten feet from the fire. He shall also exercise every precaution to prevent the fire spreading and shall carefully extinguish it before leaving the place.

10. (Synopsis). In any wooded district any person who, by himself or his agent, shall (*a*) after cutting down trees on any road allowance or railway or telegraph line, or on any other lands, set fire to the same, or (*b*) gather trees into log heaps and set fire thereto, or (*c*) set fire to trees lying on the ground, or (*d*) for any purpose whatever set fire to any standing trees, brush, meadow or hay on other land under such conditions as shall render it dangerous or probable that the fire will spread and cause destruction of timber or property, shall on conviction of any of the foregoing offences be fined in a sum not exceeding $200 nor less than $20 for each offence, and in default of payment shall be committed to jail for a term not exceeding twelve months.

11. No person shall from the first day of April to the fifteenth day of November in any year light a fire in any wooded district for any purpose whatsoever, excepting by this Act otherwise provided, unless and until permission in writing shall have first been given by the nearest fire guardian, or fire guardian specially appointed by the Minister for carrying out the provisions of this section, under and subject to the penalty set forth in the last preceding section. A permit may be refused if the season is specially dangerous or if the conditions are such that in the opinion of the fire guardian or forest or fire ranger there is danger of the fire spreading beyond control, or if the conditions which the fire guardian or forest or fire ranger considers necessary to prevent fire spreading have not been complied with.

13. Any person who throws away or drops any burning match, ashes of a pipe, lighted cigar or cigarette, or any other burning sub-

stance, or who discharges any firearms, shall completely extinguish, before leaving the spot, the fire of such match, ashes of a pipe, cigar, cigarette, wadding of the firearm or other burning substance.

Extracts from the Laws of Saskatchewan

The Prairie and Forest Fires Act, Chapter 21, 1917

3. Any person who directly or indirectly, personally or through a servant, employee or agent:

(*a*) kindles a fire and lets it run at large in any woods, or, on prairie, meadow, marsh or other open ground not his own property; or

(*b*) kindles and leaves a fire burning, without taking effectual means to prevent its spreading in any woods, or on prairie, meadow, marsh or other open ground not his own property; or

(*c*) intentionally or by carelessness permits fire to pass from his own land to the injury of the property of another person; shall be guilty of an offence and liable on summary conviction to the penalties mentioned in section 34 of this Act.

4. (Synopsis). Any person may kindle a fire in a wood or prairie or other open ground for cooking, warmth, branding or other industrial purpose on condition that he shall select a place where there is the smallest quantity of combustible material or the least likelihood of the fire spreading, and that he shall before lighting the fire clear the ground of brushwood, leaves and other inflammable matter for a radius of ten feet from the fire. He shall also exercise every precaution to prevent the fire spreading and shall before leaving the place carefully extinguish it.

7. Any person who, by himself, his servants or agents or anyone acting by or under his authority, in the process of opening up a road allowance, private road or trail, obtaining fuel, clearing the right of way for a railway, telephone or telegraph line or route, or clearing land for any purpose whatever, cuts any timber bush or brush, shall cause the fallen timber, timber slashings and refuse to be collected into piles suitable for burning on such right of way, road allowance, private road, trail or clearing, and shall burn the same at the time of cutting, provided that:

(*a*) the circumstances and surrounding conditions are such that there will be no probable danger from spread of the fire; or

(*b*) a sufficient number of men are present to prevent it from spreading; otherwise such fallen timber, timber slashings and refuse shall be burned between the fifteenth day of November following the date of cutting and the first day of April then next ensuing.

8. Any person who, by himself, his servants or agents or any one acting by or under his authority, sets fire to timber standing in the

soil, or to fallen timber, timber slashings or refuse in such manner and under such circumstances and conditions as render it dangerous or probable that the fire will spread and cause the destruction of wood, timber or property not his own, shall be guilty of an offence and liable upon summary conviction to a penalty of not less than $50 nor more than $200, and in default of payment thereof to imprisonment for any term not exceeding twelve months.

9. No person shall, without the written permission of a fire guardian, set fire to or burn any trees, brush or shrubs while standing in the soil, or any fallen timber, timber slashings, wood, branches, brushwood, plants, black loam or light soil, between the first day of April and the fifteenth day of November next ensuing, within:

(*a*) any area north of township 50, excepting township 51 in ranges 16 to 28 inclusive, and townships 52 and 53 in ranges 20 to 28 inclusive, all west of the 3d meridian; or

(*b*) the wooded area comprised of township 46 in ranges 7 to 9 inclusive, townships 47 and 48 in ranges 7 to 11 inclusive, and townships 49 and 50 in ranges 7 to 13 inclusive, all west of the 3d meridian; or

(*c*) six miles of any Dominion Forest Reserve.

(3) Such permission may be refused if the season is specially dangerous, if the conditions are such that in the opinion of the fire guardian there is danger of the fire spreading, or if the conditions the fire guardian considers necessary to prevent fire spreading have not been complied with.

Extracts from the Laws of Alberta

Section 2. Any person who shall either directly or indirectly, personally or through any servant, employee, or agent —

(*a*) Kindle a fire and let it run at large on any land not his own property;

(*b*) Permit any fire to pass from his own land; or

(*c*) Allow any fire under his charge, custody or control, or under the charge, custody or control of any servant, employee or agent to run at large shall be guilty of an offence and shall on summary conviction thereof be liable to a penalty of not less than $25 and not more than $200, and in addition to such penalty shall be liable to civil action for damages at the suit of any person whose property has been injured or destroyed by any such fire.

(2, in part). If a fire shall be caused by the escape of sparks or any other matter from any engine or other thing it shall be deemed to have been kindled by the person in charge or who should be in charge of such engine or other thing.

Section 3. Any person who kindles or is a party to kindling a fire in the open air for camping or branding purposes, and who leaves the same without having extinguished it, shall be guilty of an offence and liable on summary conviction thereof to a penalty not exceeding $100.

Section 4. No person shall directly or indirectly, personally or by any servant, agent or employee, kindle on any land a fire for the purpose of guarding property, burning stubble or brush or clearing land unless the land on which the fire is started is at the time it is started completely surrounded by a fireguard not less than twenty feet in width consisting of land covered with snow or water or so worn, graded, ploughed, burned over or covered with water as to be free of inflammable matter and any person kindling a fire for such purpose shall during the whole period of its continuance cause it to be guarded by three adult persons provided with proper appliances for extinguishing prairie fire.

(2) Any person contravening this section shall be guilty of an offence and be liable on summary conviction thereof to a penalty not exceeding $100.

Section 6. Nothing herein contained shall prevent any person from kindling fire before the 7th day of May in any year for the purpose of clearing any area of land not exceeding three hundred and twenty acres, if such land is completely surrounded by a fireguard not less than ten feet in width, consisting of land covered with snow or water or being so worn, graded, ploughed, burned over or covered with water as to be free from inflammable matter.

(2) Any person so kindling a fire shall cause it to be guarded during the whole period of its continuance by three adult persons provided with proper appliances for extinguishing prairie fire and should such fire be left without being so guarded or be allowed to escape, such persons shall be guilty of an offence and shall be liable on summary conviction thereof to a penalty not exceeding $100.

Section 7. Nothing in this Act contained shall prevent the overseer (or councillor) of any local improvement district from kindling a fire for the purpose of making a fireguard, but the area which it is proposed to burn must be completely inclosed by a fireguard at least ten feet in width, such as is described in Section 6 hereof, and such fire so kindled must during the whole period of its burning be guarded by such number of men provided with proper appliances for extinguishing prairie fire, not being less than four men, as will be reasonably sufficient to control such fire, and if the precautions hereby required are not taken, or if such fire should escape and run at large such overseer (or councillor) shall be deemed guilty of an offence and be liable on summary conviction thereof to a penalty not exceeding $100.

Extracts from the Laws of British Columbia

Chapter 17, part XI, 1912, as amended 1917

106. The period from the first day of May to the fifteenth day of September in each year shall be known as the close season in respect to the setting of fire; but when circumstances of unusual danger render it necessary in the public interest, the Lieutenant Governor in Council may, by Proclamation, extend the said season.

107. During the close season it shall be unlawful for any person to set out, or cause to be set out, started, or kindled, any fire in or near any forests or woodlands except for the purpose of clearing land, cooking, obtaining necessary warmth, or for some necessary industrial purpose permitted by the Minister, and unless the obligations and precautions imposed in the following sections shall be observed.

108. During the close season no person, firm, or corporation shall set out, or cause to be set out, fires in or near slashings or forest debris, standing or fallen timber, or bush land for the purpose of burning slashings, brush, grass, or other inflammable material, or for any industrial purpose, without first obtaining a permit therefor: Provided that no person shall be convicted who shall have set in good faith and with reasonable care a back-fire for the purpose of stopping the progress of a fire then actually burning.

111. During the close season every person who throws or drops any burning match, ashes of a pipe, lighted cigarette or cigar, or any other burning substance, or who uses any explosive in any forest or brush land, or at a distance of less than half a mile therefrom, shall completely extinguish the fire of such match, ashes of a pipe, or other burning substance before leaving the spot, and any fire thereby caused.

120. During the close season a watchman shall be maintained at the point where any stationary or portable engine is located in or near any forest or woodland for at least two hours following any time when said engine shall have ceased operation, to prevent the escape of fire therefrom.

121. (1) During the close season in each year it shall be unlawful for any person or corporation —

(*a*) To use or operate any locomotive, logging-engine, portable engine, traction-engine, or stationary engine using fuel other than oil within a quarter of a mile of any forest slashings or bush land which is not provided with a practical and efficient device for arresting sparks, together with an adequate device for preventing the escape of fire or live coals from all ash-pans and fire-boxes, and which does not comply in every respect with any regulations for the time being made and in force under and by virtue of the provisions of this Act:

(*b*) To operate any river steamboat using fuel other than oil on any of the rivers or lakes within the Province of British Columbia which is not provided with a safe and suitable device for the arrest of sparks from the smoke-stack thereof, complying in all respects with any regulations for the time being made and in force under and by virtue of the provisions of this Act.

(2) It shall be the duty of every person or corporation operating any engine referred to in this section to provide equipment in the way of tools, hose, and other fire-fighting appliances in accordance with any regulations for the time being made and in force under and by virtue of the provisions of this Act.

124. (3) Every person, persons, or corporation clearing right of way for any road, trail, telephone, telegraph, power, or pipe line, tote-road, ditch, or flume shall pile and burn on such right of way all refuse timber, slashings, choppings, and brush cut thereon as rapidly as the clearing or cutting progresses and the weather conditions permit, or at such other times as the Provincial Forest Board may direct, and during the close season shall obtain, before burning said material, a permit from said Board. Any person neglecting or refusing to perform and fulfil any duty imposed upon him by or pursuant to the provisions of this section shall be guilty of an offence against this Act.

It follows then, that fire is the greatest enemy of the forest. Prevent the leaving of large quantities of inflammable material on the ground and the careless setting of fires, and the greatest possible step has been taken in the preservation of our forests, whether for their use or for their beauty. Regulations and laws are good in their place, but to make them highly effective there must be a strong body of public opinion behind them. When the public come to regard careless setting of fires in the same light as any other misdemeanor, the number will be much lessened. To create this public opinion it is necessary to reach the children. Here is where the teacher has an opportunity and the opportunity brings its responsibility. The schools should undertake to build up a healthy public opinion respecting forest fires.

CHAPTER IV

FOREST DEVASTATION (*Continued*)

"There is a serene and settled majesty in woodland scenery that enters into the soul, and delights and elevates it, and fills it with noble inclinations." — WASHINGTON IRVING.

NEXT to fire the greatest enemy of the forest is the insect. If other forces did not intervene, insects would soon multiply to such an extent that every green leaf would disappear. In the constant struggle which goes on in both the animal and vegetable life around us, these forces so interact that any harmful increase of numbers of injurious insects is checked by natural means. Storms destroy and birds devour them. In northern climates winter readjusts things, and a fresh start is made the following spring, but the greatest regulating factors in their control are food supply and disease. If the food supply is consumed or destroyed, the increase must cease, while each species has its insect or fungus parasite, which preys upon it and lessens its numbers.

Man often unwittingly disturbs this play of natural forces. Sometimes, by his efforts, a certain food material is very much increased, and the insects which live upon that food increase accordingly until they become a pest, finally destroying their own food plant and often swarming to other plants where commonly they did not feed. Sometimes, in his wandering, man introduces an insect to a new

locality, leaving its natural enemies behind. Freed from the control of these, it multiplies enormously and does great harm. Thus insect pests like fires follow in the wake of man, and if he cannot by intelligence re-establish the balance where it has been disturbed, then a general and perhaps disastrous readjustment will have to take place. Whole forests may be destroyed before the food of a particular insect is sufficiently reduced to check its increase, or the growing of a valuable food crop may have to be abandoned.

Some very notable examples of destruction of forest trees by insects have occurred in Canada in recent years. The one which has become best known is the destruction of the tamaracks in Ontario and Quebec by the larch sawfly. This insect, in the larva form, eats the leaves off the eastern larch or tamarack, and repeated defoliation soon kills the trees. As this tree usually occurs in swamps, where it constitutes a very large percentage of the growth, the opportunity for the increase of the pest was particularly good. Nature had planted forests of a single species and the inevitable result happened. The destruction, which began several years ago, is almost complete in the two large central provinces, and the pest has followed the tamarack westward into Manitoba. Not only this fine tree, but also the two kindred species of larch in British Columbia are threatened with destruction. Yet this same insect has existed in Europe for some centuries and has not destroyed the larch. Serious outbreaks occur in places at times, but these are checked by natural control before

Courtesy Entomological Branch, Dept. of Agriculture.

FIG. 7. — Base of a Dying Bull Pine, Showing Tunnels Made by Bark Beetles.

the damage is very great. This is a case where man has introduced a destructive insect into new surroundings without also introducing its enemies. The larch sawfly was brought from Europe — no one knows how — and found here, in the swamps of almost pure tamarack, an ideal place for increase of numbers. Having no natural enemies to hold it in check, there was no limit to its increase so long as the food supply lasted. Dr. C. Gordon Hewitt, Dominion Entomologist, in speaking on this point says: "The enormous havoc wrought by this insect was apparently due to the fact that there existed no natural means powerful enough to control it before it had destroyed its food plant." This was because the insect was in new surroundings. Where it had lived for a long period, it must have been controlled, or it would have brought about its own destruction by consumption of its own food. Man must re-establish the natural check, or the tamaracks of the continent are doomed.

Another example of devastation on a large scale is found in the injury done by bark beetles in the conifer forests of British Columbia. The yellow pine of the southern interior of the province is particularly liable to attack and has suffered most, but the white pines and Sitka spruce are also affected. There are several species of these beetles, each working in its own way and attacking a particular kind of tree, or in some cases a single species attacking several kinds. The life histories, as well as the injuries caused by them, are so similar in all cases that no distinction need be made here.

These insects are small, nearly cylindrical, hard-shelled beetles from an eighth to a quarter of an inch in length, and of varying colors, from light brown to almost black. They enter the bark of the tree in pairs, each pair boring a tunnel upward through the inner bark or slightly grooving the wood. Some of the dust caused by the boring falls out of the openings and forms a ready means of detecting the presence of the insects. The eggs are laid in these tunnels and in a short time hatch into small white grubs, each with a strong pair of jaws. These larvæ then bore winding channels along the surface of the wood, each one finally hollowing out a chamber in which it passes into the pupa stage. From this stage it emerges a full-grown beetle, bores a passage to the surface, and escapes to select a mate and begin the process on another tree. The winter is passed in any of the three stages, and the work of destruction is going on fairly constantly all summer, but more particularly in July, August and September.

The injury is done by the network of tunnels killing the inner bark of the tree. This inner bark contains the ducts through which food material passes downward from the leaves to all other parts of the tree. The insect tunnels cut these, preventing the passage of the food supply and thus killing the tree. A bad attack has about the same effect as girdling, and will kill it in a single season.

These beetles are not new insects introduced from another country. They are native wherever forests of conifers are found. Under ordinary conditions, however, they prefer the bark of dead or dying timber, and, as the supply

of that is limited in any natural forest, they are not plentiful enough to be a serious pest. Only occasionally do they attack living trees. Lumbermen and others, in cutting timber and leaving the refuse on the ground, have provided breeding places in unusual quantities. This has caused the insects to increase to such an extent that they have swarmed out of the dead bark and attacked living trees in very large numbers. Some idea of the numbers of the insects and the seriousness of the recent attack may be gathered from the fact that the entomologist who investigated conditions in one locality reported that "from 1500 to 2000 pairs of beetles were cutting tunnels and depositing eggs in the lower fifty feet of many of the infested trunks examined."

The destruction so far has not been on a scale sufficient to affect any large percentage of the immense forests of British Columbia, but every infected tree or group of trees forms a centre from which the surrounding timber becomes subject to attack. Trees in the vicinity of towns or where lumbering has been done are in special danger.

Other insects in myriads are constantly attacking forest trees. The green aphis has been a serious pest on the Manitoba maples in Manitoba and Saskatchewan, caused no doubt by an abnormal increase in the number of trees since the region has been settled. A natural check will no doubt prevent wholesale destruction, but much damage has been done in places. A small yellowish beetle, the western willow-leaf beetle, has done considerable harm some seasons to the willows and poplars in the prairie provinces, and

cankerworms have been a rather serious pest here and there, particularly on the Manitoba maples. Numerous gall-producing insects and leaf-curlers are also at work, but usually the harm done is quite local and often confined to a single tree or group of trees. These are the natural enemies of the trees and under natural conditions are held in check. The injury done is seldom widespread and affects trees in streets, parks and gardens rather than those of the forest. Local outbreaks can generally be controlled by the mechanical means suggested in another chapter.

Fungous diseases differ only in detail from insect attacks. They are the attacks of one living organism upon another. Any plant with green leaves is able to take food material out of the air, and this, along with what it gets from the soil, suffices for its support and growth. A plant which has no green coloring matter in it cannot do this. It must get its food ready made, and thus is compelled either to live on the decaying bodies of dead plants or animals, or else attack and live upon a growing plant. One of these plants which lacks the green coloring matter is called a *fungus*, and when it lives on another living plant it is a *parasite*. The effect of the parasite upon the growing host plant, if injurious, is spoken of as a *disease*, and trees are subject to the attack of these fungous diseases.

The fungus produces a threadlike body called a *mycelium* which enters the host and grows through it, forming a dense network. The food which should nourish the host is absorbed by the parasite. When this food begins to fail, either through the advance of the season or the death of

the host, the fungus sends out certain bodies to the surface which produce large numbers of spores, and from these spores new plants may grow. These fruiting bodies take various forms, but the shelf fungus so often seen projecting from a dead or dying tree is one of the most common.

All the poplars are subject to fungous diseases, the aspen particularly so. It is quite common to find the aspens dying along the route of an old fire where there is a large quantity of decaying timber, or in groves which have been cleared of undergrowth and are used for park purposes. Examination will show that these trees have fallen victims to some fungus.

The most dangerous disease of this kind which has to be dealt with at the present time, 1919, is a form of rust, which is attacking the white pine of eastern Canada and the eastern States. The rusts are fungi which live on two hosts, producing different spores on each host, the spores varying greatly in appearance. The name rust comes from the fact that in certain plants the spores of one kind are red or yellow and discolor the hands or clothing much as iron rust would. The rust of wheat is, perhaps, the best known example of this. The disease which is attacking the pines is known as the white pine blister rust, and its alternate host is the black currant or any member of the genus *ribes*, which include both currants and gooseberries. The spores which are formed on the currant grow in the young tissue of the pine and destroy the leaves, in the end killing the tree. It is particularly injurious to young trees.

This disease has practically destroyed all the white pines

of Europe and has now obtained a foothold in the eastern States. From there it has invaded Canada and has been detected in the Niagara peninsula and in Quebec. As the white pine is one of the most valuable timber trees of the eastern part of the continent, its threatened destruction is a serious matter.

CHAPTER V

FOREST PRESERVATION (ORGANIZATION)

FOREST preservation does not, of necessity, mean the continuation of all the forest at present standing, or of any particular part of it. It means the preservation of a sufficient amount to maintain a proper balance between wooded and cultivated areas and thus ensure a supply of forest products, conserve the water in the basins of the streams, protect wild animal life, break the sweep of the wind and beautify the landscape. Usually there is sufficient land unfit for cultivation to support all the forest necessary. Streams generally rise in rough hilly regions, and their basins contain considerable land unfit to till. This broken country is the natural haunt of wild animals, and its irregularity gives that break to the sky line which makes for beauty of landscape. Let the land be wooded which would otherwise be waste, and the forests properly preserved, and the cultivated parts will not only be more productive but also more pleasant places in which to live.

This might involve the clearing of some land now in forest and the re-foresting of a good deal now lying waste, as well as the proper protection of much forest now standing. The process is slow. A forest is planted for coming generations, but what does it matter? It is only the ex-

ploiter who grasps all for himself, or longs to see everything used during his own lifetime. The true forester works for posterity. At best we cannot hand on the magnificent forests we received from nature, but let us bequeath something more than denuded hills and blackened trunks.

The proportion of the area of any country which could be profitably left in forest is worthy of careful consideration. It is evident that there is a limit somewhere, although it is not possible to state it in exact terms, for it is always a relative matter. Land which is valuable for cultivation need not be devoted to forests, but we must be careful not to devote to other purposes land which should properly be forest. A good forest is much more valuable than poor farms. A knowledge of the area devoted to the growth of trees in European countries where conditions have reached a somewhat permanent basis will help us here.

Belgium is perhaps the best European example of manufacturing industry combined with intensive cultivation of the soil. Before the war its population was more than 650 to the square mile. The artisans working in the cities lived long distances out in the suburbs, going to and from their homes by a system of radial railways. Every foot was carefully cultivated and yet 18 per cent of its area was devoted to permanent forests. France was about 20 per cent, Sweden about 66 per cent, Germany about 25 per cent, and Austria about 30 per cent forest. These figures, of course, all apply to conditions before the war. They show that for a country to be able to support per-

manently a dense population a large proportion of its area must be in forest.

What is true of Europe is true also of Asia. India owes its comparative freedom from famine in recent years to the re-clothing of much of the land with trees, and 66.7 per cent of the area of Japan is forest.

When the area of forest in any of the Canadian prairie provinces is compared with what has been found necessary in these very old countries the contrast is almost startling. Manitoba has 1.6 per cent, Saskatchewan 3.8 per cent, and Alberta 10.3 per cent of its area in forest. In these provinces at least we have a long way to go before reaching a condition that may be regarded as satisfactory and permanent.

Canada is a comparatively new and a very large country. Its natural forests were so extensive that they were for long enough considered practically inexhaustible. No one thought it necessary to know just what extent and what kind of forest we had, since all were assured we had and would always continue to have plenty. It is only within recent years that the idea has gradually been driven home to the people, that our forests are being rapidly destroyed, and that some method of protection is necessary if suffering is to be avoided.

It soon became evident that for effective protection there must be strong central control. Fortunately this was still possible, for although large areas of land had been disposed of either by homestead, purchase or grants to railways, there still remained sufficient public lands to

supply great national forests. Practically all the lands unfit for agriculture are still in the possession of the various governments. In the four older provinces and in British Columbia these crown lands are owned and controlled by the provincial governments. In British Columbia, how-

FIG. 8. — A Fire Ranger's Lodge. Lake Nipigon.

ever, a strip about 20 miles on each side of the main line of the Canadian Pacific Railway, known as the "Railway Belt," and the "Peace River Block" in the northeast corner of the province, are under Dominion control.

In the three prairie provinces the crown lands are still owned by the Dominion and managed by the Department of the Interior. In Manitoba the swamp lands were handed over to the province in 1885, but those which remained unsold were given back to the Dominion in 1912, when the boundaries were extended to Hudson's Bay. This possession of the forest areas by the various governments

assures central control. All the provinces that control their own crown lands now have departments for their administration, while the Forestry Branch of the Department of the Interior has been formed to protect the forests of the prairie provinces. The Dominion Forestry Branch is a branch of the Department of the Interior with head office at Ottawa, and supervises the complete work in the western provinces through the Director of Forestry. It has supervision only of the areas set apart for Dominion forests in the provinces of Manitoba, Saskatchewan, Alberta, the "Railway Belt" in British Columbia, the Peace River Block in northeastern British Columbia and the Northwest Territories. It also supervises the protection of forested areas of Dominion lands in these provinces which are organized into what are called fire-ranging districts.

The forest reserves and fire-ranging districts are organized according to provinces, each supervised by a district inspector of forest reserves. There are four of these inspectors, with offices in Winnipeg, Prince Albert, Calgary and Kamloops respectively. The district inspector has complete supervision, subject to the head office at Ottawa, of the forestry organizations in his province. His work is divided into three main parts, administration of the area permanently set aside as Dominion forests, supervision of the forest protection organized in connection with each fire-ranging district, and oversight of the fire protection organized along the railway rights-of-way, along with the chief forester of the Board of Railway Commissioners.

The very size of Canada and the lack of knowledge of the territory covered by her widely scattered forest regions make it necessary, in the first place, to secure accurate knowledge of the conditions. A survey of the territory

Courtesy Forestry Branch, Interior Dept.

FIG. 9. — Railway Fire Patrolman Traversing His Beat on a "Speeder."

to be covered is the first necessity after the formation of an organization for forest control. This is being done as rapidly as the great extent of the work and the available staff will permit. At least, lack of survey is not holding back other work which it is possible to do at present.

While organization and a knowledge of the territory are both necessary, they alone would not produce results. There must be a very definite plan of management. A study of the practice in those parts of the world where

forestry has been followed as a progressive science will help here. The preservation of the European forests and the development and continuance of forests in India are the world's best examples of scientific forestry. The plan followed consists in having certain suitable territories set aside as national forest reserves. The details of administration of the reserves vary greatly with varying conditions, but the principle of national forests reserved for that purpose obtains wherever forest preservation has been seriously attempted. This, too, is the plan that is being followed in Canada. Most of the provinces that control their timber lands have made a start in this direction, and the Dominion has set apart reserves in the prairie provinces and in the railway belt of British Columbia. The Dominion forest reserves at present either completely or incompletely organized are as follows.

Manitoba	Area
Porcupine Forest Reserve No. 1	777½ square miles
Turtle Mountain Forest Reserve	109 square miles
Spruce Woods Forest Reserve	224 square miles
Riding Mountain Forest Reserve	1,499 square miles
Duck Mountain Forest Reserve No. 1	1,462 square miles
South Manitoba Fire Ranging District	26,900 square miles
North Manitoba Fire Ranging District	27,000 square miles
The Pas Fire Ranging District	6,500 square miles

Saskatchewan	Area
Cypress Hills Forest Reserve No. 2	97½ square miles
Moose Mountain Forest Reserve	156 square miles
Beaver Hills Forest Reserve	99 square miles
Porcupine Forest Reserve No. 2	3,247 square miles
Pasquia Forest Reserve	2,615 square miles
Fort à la Corne Forest Reserve	513 square miles

Saskatchewan	Area
Steep Creek Forest Reserve	7 square miles
Pines Forest Reserve	166 square miles
Nisbet Forest Reserve	149 square miles
Sturgeon Forest Reserve	729 square miles
Big River Forest Reserve	1,342 square miles
Seward Forest Reserve	31 square miles
Elbow Forest Reserve	119 square miles
Dundurn Forest Reserve	63 square miles
Keppel Forest Reserve	86 square miles
Manito Forest Reserve	180 square miles
Duck Mountain Forest Reserve No. 2	81 square miles
Battleford Fire Ranging District	9,595 square miles
Prince Albert Fire Ranging District	29,376 square miles

Alberta	Area
Cypress Hills Forest Reserve No. 1	81 square miles
Cooking Lake Forest Reserve	95 square miles
Crowsnest Forests	1,309 square miles
Bow River Forests	2,705 square miles
Clearwater Forests	4,718 square miles
Brazeau Forests	2,244 square miles
Athabaska Forests	3,260 square miles
Lesser Slave Forest Reserve	5,023 square miles
Edmonton Fire Ranging District	77,220 square miles
McMurray Fire Ranging District	20,000 square miles
Mackenzie Fire Ranging District	3,250 square miles

British Columbia	Area
Yoho Forest Reserve	164 square miles
Glacier Forest Reserve	106 square miles
Larch Hills and Mount Ida	68 square miles
Fly Hills	224 square miles
Monte Hills and Martin Mountain	217 square miles
Niskonlith	317 square miles
Long Lake	263 square miles
Tranquille	291 square miles
Nicola	506 square miles
Arrowstone	255 square miles

British Columbia	Area
Hat Creek	340 square miles
Coast Fire Ranging District	3,200 square miles
Revelstoke Ranging District	2,520 square miles
Salmon Arm Ranging District	3,970 square miles

These reserves have been selected with the greatest care. They include not only those regions more suitable for growing timber than for any other purpose, but also they usually protect the sources of streams or include stretches of sand which, if ploughed, would endanger adjoining farms. The drifting sand will travel with the prevailing wind and literally bury farms. This menace is a very real one in many places on the shores of the sea or the Great Lakes.

Shifting sand dunes are a terror to the owners of adjoining property and are very difficult to control. The sand hills found in different parts of the prairie region are but the dunes of an ancient shore. The retirement of the water has enabled them to become clothed with grass, trees or bushes, and they are, therefore, safe. If this cover is thoughtlessly or ignorantly destroyed by trying to bring these stretches under cultivation, the sand will be released, to be blown ahead of the wind and become an annoyance if not a positive source of danger. In spite of the value of these reserves and the care that has been bestowed upon their selection and administration, the charge is sometimes made that settlers intentionally set out fires where they will burn over portions of the reserve, in order to increase the probability of the land being opened for homesteads.

Any one who would be guilty of this is unfit for citizenship in a free country.

Each reserve is under the charge of a supervisor. He does the business connected with its administration and lays out the work to be done. Under him, on the larger reserves at least, is a forest assistant who is the technical adviser to the supervisor. He is a trained forester, a graduate of some school of forestry, and looks after all work which requires that special training. The reserve is divided into a number of districts, each under a permanent forest ranger. This official is required to live in his district, in a house provided for him, and to patrol it regularly to protect it from fire or trespass, as well as to do much necessary work. So far as actually doing things is concerned, the forest ranger is the most important official on the reserve. He must be able to manage a canoe in the water or carry it across a portage. He also cuts roads, builds telephone lines, cabins and lookout stations, fights fire, estimates standing timber and measures it when cut. In short, he is a man of all work, and should be strong, experienced, skil-

Courtesy Forestry Branch, Interior Dept.

FIG. 10. — A Lookout Tower on a Dominion Forest Reserve.

ful and resourceful. To secure such men is not easy. Only the forest can produce them, and it cannot give the literary and mechanical training necessary. Other countries have found it advisable to establish schools for forest rangers, and Canada will no doubt have to do

FIG. 11. — Fire Rangers' Notice on the Kemogami River, 125 Miles North of Jack Fish, Ont.

likewise. A small beginning has already been made in this line of work by the institution of a course suitable for forest rangers in connection with the vocational work of the Military Hospitals Commission at Vancouver, B.C. These should only add to, not replace, training which the forest gives. The forest ranger must continue to be the natural son of the forest, not the artificial product of a school. The Director of Foresty gives the qualifications of a forest ranger as follows:

1. Physical fitness, to be attested by medical certificate.

2. Age, which on appointment should be between 21 and 45.

3. Experience in bush work, including scaling and cruising of timber.

4. The running of a line by compass and determining distance by pacing.

5. The packing of horses in some districts.

6. Reading, writing and arithmetic sufficient to read instructions, write replies to letters and calculate the dues on any of the ordinary permits issued on forest reserves.

The Canadian forest has always produced good men and will continue to supply the material for the best of rangers, if efficiency is made the basis of appointment and ability is rewarded by promotion.

Provision is made for the inspection of reserves by combining them into four inspectoral districts with an inspector for each. The inspector, in consultation with the officials of his district, makes an estimate of the kind and amount of work necessary and the amount of money needed, and submits this to the Director of Forestry. He also inspects the books and records, and in a general way supervises the organization of the work of the reserve.

CHAPTER VI

FOREST PRESERVATION (ADMINISTRATION)

"For many a century nature fed them and dressed them every day, — working like a man, a loving, devoted, painstaking gardener."
— JOHN MUIR.

THE administration of forest reserves includes a number of separate features, the first of which is protection. This means not only protection from the forest's greatest enemy, fire, but also from its lesser enemies, such as insects, disease and the destructive axe of the trespasser. The forest should be not only protected but used. A national forest is first of all for use, and when timber is matured, it should be cut and removed for the service of man. The regulation of this cutting and the proper disposal of refuse form an important part of the forester's work. Provision must also be made for new trees to take the place of those cut away. It may, and often does, go further, and includes the reclothing of open stretches with a growth of trees. All of these things must be attended to, and they all mean work, which is always exacting and often dangerous. Such work must be done thoroughly and honestly, and no one need regard any of the positions in connection with a forest reserve as a sinecure. Each office, however, gives opportunity for necessary and valuable public service.

The protection of the reserve from fire is the most difficult work of the forest ranger. Fireguards are made through or around the reserve, where they will stop or prevent fires. Trails are cut through the forest to make travel from one part to another less difficult, and lookout stations are built in convenient places. These stations are connected by telephone with the headquarters of the reserve. The ranger must patrol his district regularly, spending the nights in cabins built for the purpose, usually by his own hands. Each cabin contains, besides the necessary camp equipment, tools for fighting fire. The ranger patrols on foot, by canoe or on a railway motor cycle, just as circumstances permit. If, from a lookout station, he sees smoke in any part of the reserve, he can summon help by telephone, and in that way reach and extinguish the fire before it has done much harm. Small gasoline engines with considerable length of hose, that may be carried from place to place, are being added to the fire-fighting equipment and add greatly to its usefulness.

Not an unimportant part of the ranger's work in prevention of fires is educational. The greater number of fires are caused by the carelessness of settlers or travellers. This is due more to ignorance of the harm that may follow and the means of preventing it, than to intention. By the posting of bulletins and other means, people are instructed what measures to take to prevent fires and warned of the punishment for negligence.

All land under Dominion control and not included in the forest reserves is divided into fire-ranging districts. Most

of these districts are directly supervised by permanently appointed chief fire rangers. The activity in connection with the fire-ranging districts begins about the middle of March or later and closes in October or November, according to the season. In these districts are temporarily appointed each year fire rangers and assistant fire rangers, who are placed in charge of certain areas of patrol, and their duty during the danger season is to cover the area completely, for the purpose of detecting and preventing the spread of any fire which may occur. They are assisted in the better organized districts by lookout towers and telephone lines, which make it possible to detect fires at a distance and to collect a gang of men at short notice as soon as a fire is discovered.

Fire-ranging on the railways is under the supervision of a permanently appointed divisional fire inspector who organizes the railway fire-ranging in the provinces of Manitoba, Saskatchewan and Alberta. Railway fire guardians are placed along the rights of way during the danger season and are provided with either hand, pedal or power speeders on which they travel up and down the line on patrol beats assigned them. In this way we have the co-operation of the railways, and, as a result, the fire menace from them is being greatly reduced.

The protection of forests from insects and disease is not an easy matter. It is not possible by mechanical means, such as spraying, either to prevent the coming of the pest or to destroy it once it has come.

The only practical way of controlling those insect pests

which occur over a wide area is by biological rather than mechanical methods. The control of the gipsy and brown-tail moths in the eastern States, by importing their insect enemies, affords the best known illustration of this method.

Another good example of this is seen in the treatment of the larch sawfly. One of the chief means by which this is controlled is by the attack of insect parasites. The sawfly did not seem to have any deadly parasite among natural Canadian insects and thus was able to run its course unchecked. A study of conditions in England by Dr. Hewitt revealed the insect which prevented the sawfly becoming a serious pest there. This insect enemy was introduced into Canada and distributed, not only in Ontario and Quebec, but also in several places in Manitoba. This parasite has now become well established through the whole range of the sawfly, and the destruction of the larch is decreasing. Several other parasites which prey upon the sawfly have been introduced and are bringing it under control. Some good is also being done by some native species, and we may look for a re-establishment of the balance that has been disturbed.

In British Columbia bark-beetles have done great harm. These multiply very rapidly in fallen timber and from there are likely to attack the green trees, especially the weaker ones. But nature as a rule does not have great quantities of fallen timber in one place, and under natural conditions these insects only occasionally did much damage to standing trees. With the advent of the lumbermen this was changed. Large quantities of refuse were left on the

ground after the cutting. This was the natural breeding place of many bark-boring and wood-boring insects, which have increased so rapidly that they have now attacked the green timber. This danger threatens the white pine, yellow pine and spruce forests of the province, but it can be controlled. These beeties prefer the bark of dying trees for breeding places, and it is only when their numbers are so increased that there is not a sufficient quantity of this dying bark that they attack the green timber. If their numbers are decreased so that the usual amount of dead or dying timber will satisfy them, they will do no harm. Their numbers, however, were greatly multiplied by enormously increasing the dead timber by the refuse from the cuttings. When the increase of the cutting could no longer keep pace with the increase of the insects, they attacked the green trees. Their number must again be decreased, and no opportunity again allowed them for such rapid increase. This can be done by cutting all infected trees, destroying the rubbish, and keeping the forest clear of slash in the future.

The beetles pass the winter in the bark of trees attacked the previous season. These "yellow-tops" can easily be recognized by their dying foliage. The needles have not all fallen off, but have turned yellow. If these trees, or a very large percentage of them, are cut and handled in such a way as to destroy the wintering insects, a great step will have been taken toward checking the outbreak. The ways suggested for handling the timber are either floating it in water, cutting in winter and burning the refuse, or peeling

the logs and burning the bark. By thus reducing the numbers of the insects and preventing the balance being again disturbed, the valuable pine and spruce forests of the province may be protected, but neglect will probably mean disaster.

The protection of trees from fungous diseases usually applies more to orchards, parks and city streets than to the forest. In them curative methods are resorted to, as the preservation of the individual tree is the aim, but in the forest the single tree is not considered if it threatens the whole. Fungous growths are always present, but if diseased trees are removed or burned and the quantity of decaying wood kept down to the natural amount, the health of the forest as a whole will seldom suffer.

With disease as with insects, however, there is always the danger of introducing something new, and this has been done in America in the case of the white pine blister rust. This disease came from Europe, and, if not checked, will destroy the white pine forests of America. The best way to fight it is to destroy its alternate hosts, the currants and gooseberries. This is a difficult and expensive undertaking and may mean loss to fruit growers, but the danger is great. The fight is confined to the eastern provinces and the eastern United States, but as the white pine forests of British Columbia are threatened, the western provinces are deeply concerned.

The combined appropriations of the federal and state governments in the United States for the purpose of fighting this disease amount to more than a half million

dollars, and the provinces of Ontario and Quebec, with the co-operation of the Dominion government, are assisting. Every effort is being made to locate any outbreaks and prevent its spread. Forty inspectors are searching for it in the Canadian provinces, and a strip of territory one mile wide along the Ontario side of the Niagara River has been entirely cleared of currants and gooseberries, while a similar strip is likely to be cleared on the American side.

A suggestive feature of this campaign is the employment of school children to locate the disease on the currants and gooseberries. It can be easily detected at that stage, and the children make good scouts. There are many problems of real life which could in this way be brought into the schools, making the school work more real and its relation to life of the people closer. The problem of arousing public interest in forest preservation is worthy of the attention of teachers.

This is not a place for a treatise on plant diseases or insect pests. A few have been mentioned to show the nature of the problems with which the forester has to deal. It is not to be expected that every forest ranger, or even every trained forester, is sufficiently familiar with these matters to deal with them single-handed. They must often call specialists to their aid. The entomologist, the botanist and the plant pathologist must be consulted. But the forest ranger should know healthy from diseased trees and report any signs of injury from causes unknown to him. He should keep the forest free from those con-

ditions which attract disease. All refuse, from whatever source, should be burned and the surroundings kept favorable to healthy growth. In short, the forest ranger should be the sanitary inspector of the forest, but at times it may be necessary that he call in the physician.

The proper use of the reserve is no less the forester's work than its protection. Every possible means should be provided whereby most use will be made of the timber. It should also yield a revenue, but money raised from the forest should be spent on it. The forest, like the land, is the gift of nature and should be used and handed on unimpaired either as to its present production or its possibilities. The policy of using the timber resources as the mineral resources are used cannot be defended.

In order to secure control of the cutting on reserves no timber is allowed to be cut except on permit. The permit provides that only mature trees, or those which for some special reason should be removed, shall be taken. The forester in charge marks the trees and inspects the work to insure that the regulations are adhered to. Not all the mature trees are allowed to be cut, as care must be taken to leave some to supply seed for starting new growths. Different species begin the production of seeds at different ages, and care must be taken that some trees old enough to bear seed are left. It is also necessary to provide that these are in such positions that they will not be blown down. If forest trees are left exposed to the full force of the wind, they will soon fall. If all but a few of the large trees are removed, leaving them distinctly higher than the sur-

rounding growth, they will also suffer by windfall. To prevent this they are either left in blocks sufficiently large to protect themselves, or in places where they are naturally protected by other means.

It is also a part of careful cutting of timber to have all trees cut by the saw and the stumps left low. No stump should be more than eighteen inches high. Then too, the least possible injury should be done to the young growth, and all the timber cut should, as far as possible, be used. What will not furnish saw timber should be taken away for fuel, and all brush and other refuse should be piled and burned at a time when the fire cannot spread.

In European countries these regulations are easily enforced. The forests are so close to centres of population that every part of the tree can be profitably disposed of, and even the smallest branches will be taken away. In Canada, owing to the greater amount of forest and the more scattered population, the disposal of waste will be less economic. Much timber, which could be used if there were people to use it, will of necessity have to be burned. The practice of just trimming the trees, so that all the branches fall on the ground, is no longer regarded as a satisfactory disposal of brush. Decay in the Canadian woods is not rapid enough for this to be a sufficient safeguard against fire.

If a forest is to furnish a continual supply of timber, care must be taken to keep a constant supply of young growing trees. A well-stocked forest properly managed will usually seed itself. The open spaces left by removal

will admit the light required to stimulate the growth of young trees, and the crowns of the growing timber will furnish the shade needed for the germination of seed and to prevent grass getting possession. All trees do not stand shade equally well, and if the growth of light-loving trees is to be encouraged, some thinning may be necessary. The species which are more "tolerant" of shade often gain in the struggle against those which require more light. In preserving the proper balance of species the help of the forester may be needed, as pure stands of a single species make conditions favorable to any disease or pest to which that species is subject. At times planting may be necessary, even here, but the forest itself will usually furnish the young trees.

In Canada, however, owing to repeated fires, large tracts have been practically stripped of trees which must be replaced. If the burning has been severe, the layer of mould on the surface may be burned away, leaving a poor seed-bed; or if grass gets possession of the ground before trees get a start, it makes the re-foresting by nature very unlikely. The dry grass is likely to be burned off every few years, and any seedlings will be killed. If, however, grass does not take possession, the ground will likely be occupied by poplar and birch. These trees, by reason of their rapid growth, the spreading of their seed by the wind and reproduction from the root, will soon cover the ground to the exclusion of all others. The aspen will spread even in ground occupied by grass, and on the prairies there are many groves now containing trees large enough for fence

posts and fuel, which have grown up since the surrounding land has been cultivated. The cultivation has protected them from fire, and the natural vitality of the trees has overcome the grass. But these are not the most valuable species, and nature is slow in replacing them by others. If the seed of conifers is available, their seedlings, protected by the shade of the poplars, will gradually grow up and in time overtop the poplars. This stage of the re-establishing of a forest is well illustrated along the main line of the Canadian Pacific Railway north of the Great Lakes. There may be seen quite a vigorous growth of pine and spruce emerging from what a few years ago was a complete cover of poplars and birch. In time other species will establish themselves, and, under favorable conditions of climate and soil, the hardwoods will replace the conifers. While this is perhaps the only way in which large areas can be re-clothed, it is very slow. There are times and places where conditions are such that seeds of the desirable species are not available, or a quicker method is desired, and then artificial planting must be done. Just as the custodian of a forest must know when to cut as well as how to tend his trees, so he must know how to plant. The output must be continuous, and growth must balance with consumption.

The supervisor of a forest reserve must understand all these processes thoroughly. On him devolves the duty of laying out the work and its general supervision, and this requires both knowledge and judgment. Still the direct oversight of much of the work falls to the lot of the forest

ranger. He must cut the trails, fight the fires, estimate timber and supervise its cutting. His duties require a rare combination of shrewdness, skill, endurance and honesty; and his services, even when rightly performed, are seldom fully appreciated.

CHAPTER VII

TREE GROWING

"There is something nobly simple and pure in a taste for the cultivation of forest trees. It argues, I think, a sweet and generous nature to have this strong relish for the beauties of vegetation, and this friendship for the hardy and glorious sons of the forest."

— WASHINGTON IRVING.

FOR tree growing the first requisite is well-prepared soil. This is so essential that it is mentioned first and perhaps will also be mentioned last in the chapter, so that its importance may not be underestimated. It is not absolutely necessary to have any particular kind of soil, but it must be well prepared. There are trees for sand and trees for clay; trees for wet places and trees for dry; trees that endure shade and trees that require light; but all alike do best on well-prepared soil. The preparation required is that which would be made to furnish a seed-bed for any field or garden crop. A good summer fallow, or land on which roots have been raised the previous year, or well-tilled garden soil are the most suitable. In districts where the rainfall is light, as is the case throughout the greater part of the prairie region, summer fallow is preferable, as part of the rainfall of two seasons is stored in the ground. In fact the superiority of the summer fallow over land prepared in any other way is so great that for several

years the Forestry Branch has insisted that the land be prepared that way before material to plant it will be supplied. It is claimed that trees set on garden land or backsetting have not given the best results. Soil should be not only well prepared, but also, for most trees, it should be reasonably deep and well drained. There may be rocks, provided they contain crevices through which water can drain away and the roots pass, and the soil condition still be good. An unbroken bed of rock, or the general water level too near the surface, will usually injure the growth. Good drainage prevents not only the presence of surplus water, but also the collection of soluble mineral salts. Strongly alkaline or strongly acid soil is not suitable.

In deciding what trees to grow, there are two points which need consideration before all others; they must be adapted to the climate and to the soil. Length of life, rate of growth and many other things are important, but need be considered only after adaptation to soil and climate is assured. It does not matter how slowly or how rapidly a tree grows nor how long it lives, if it will not stand our climate or soil. To some extent soil and climate interact on each other. For instance, if a tree has suffered for lack of suitable soil, the climate may either tend to make up for this unfavorable condition, or it may complete the work of destruction which the soil has begun. A congenial climate may make up for poor soil, or rich well-drained soil may offset a severe climate.

Sometimes the purely local conditions will decide the effect of climate on a tree. A sheltered glen may support

a vigorous growth which would not stand the exposure of the hilltop. A northern slope, because it retains the snow longer in the spring and is therefore more moist, is frequently well wooded, while the southern exposure is parched and naked.

When it has been decided that certain trees are adapted to the soil and climate, modified as these may be by local conditions of drainage or exposure, then other characteristics may be considered. The persistence or length of life of a species and its rate of growth should be taken into account. Trees which grow rapidly will give results sooner than those of slower growth, but cannot be depended upon to last as long. In establishing a forest the rapid growers, like the poplars and birches, often take possession of the ground and form a cover which protects the slower types until they get a start. These in turn take possession and form a more permanent growth. For ornamental planting the same result can be secured by mixing the poplars and willows with conifers and hardwoods. The one type gives quick results and the other insures permanency.

The liability of a species to insect attacks or fungous diseases also affects its value, either as a shade or a forest tree. In considering this, however, it is well to remember that a pure stand of any species is likely to promote the increase of any pest or disease to which it is at all subject. In Manitoba, of recent years, the Manitoba maple has been much injured by repeated attacks of the green aphis. This is no doubt partly due to the fact that this tree is subject to that pest, but it is also due to the trees being so plentiful

and in most cases growing unmixed with other kinds. For a long time this was almost the only tree planted. It lines the streets of every town and is largely used for shelter belts on the farms. The result which always follows the unusual increase of a single species has done so in this case. Its enemy has increased in proportion and has done great harm. Professor Fernow, in pointing out this result of growing a single species, says: "a city of elms, for example, is naturally apt to become a city of elm-beetles, the elm otherwise being no more subject to insect pests than many other species which are supposed to be immune, because the opportunity for extraordinary multiplication of its enemies has not been given."

Cleanliness of habit, vitality, light and moisture requirements, shape of crown, amount of shade or value of the wood for fuel, lumber or other purposes, are all things to be considered, and trees should be chosen according to their value for the purpose for which they are grown. Mention of the particular nature of each species in these and other respects will be made when treating them separately, but it must be considered that all trees of the same species are not exactly alike. Great variation among the individuals will be found.

The two methods of procuring trees are by transplanting them from where they have been growing, or propagating them from seed or cuttings. If they are to be transplanted, the sources are either the natural growth of the woods or stock from a nursery. In some respects the trees from the woods have the advantage. Their adaptation to climate is

assured, and the kind of soil and location they prefer is evident, both from the place where they grow and their condition. Then, too, as they have grown in the shade, they have been pruned by nature from the seedling stage onward, and usually have clean straight trunks. Their disadvantage is that, having been grown from seed germinated on top of the ground and always protected from the wind, their root system is spread out widely on the surface. The greater part of the small root fibres, which alone bear the root hairs that absorb moisture from the soil, are at the outer rim of the root system and somewhat distant from the trunk. In digging, these are cut away and the tree thus has to produce fresh ones before it can establish itself in its new location. This makes trees from the woods more likely to die in transplanting, and slower to establish themselves than the same species grown in a nursery. Cultivation and frequent moving keeps the root system of trees in the nursery more compact, and thus less of it is removed when they are transplanted. With care, however, good results can be secured from forest trees. They should be planted somewhat deeper than they grew naturally, and severely pruned back so that the leaf system will not evaporate more moisture than the root system can absorb. This cutting back of the top also lessens their resistance to the wind and makes them less likely to be loosened before they become rooted. It is a wise precaution to stake any trees in exposed positions to prevent swaying.

Nursery stock will establish itself more quickly, grow faster for the first two years and has generally a more

sturdy stem. Unless it has been carefully and skilfully raised the trunk is likely to be rough from frequent artificial pruning.

The size of the tree and the time of year are important factors in transplanting. Generally speaking no time is

FIG. 12. — A Corner of the Nursery at Brandon Normal School.

saved by trying to plant trees that are very large. The young tree starts to grow more quickly, soon overtakes a larger one planted at the same time, and often surpasses it in a few years. Species of strong vitality, like the willows or some of the poplars, may be moved when it would be unsafe to move more slow-growing trees of the same size. When making large plantations, it would be unwise to use any other than very young trees. There are times, however, when it is desirable for special reasons to move a large tree, and with sufficient care any tree can be

transplanted, if the mechanical appliances for digging and handling it can be supplied.

The moving of full-grown specimens is a special department of street and park work and need not concern us. The care required is just about in proportion to the size of the tree. "Transplanting a tree from one site to another is a surgical operation during which the patient needs special attention." Particular attention is required in the digging. As large a root system as it is possible to handle should be left, and if the tree is large and only to be removed a short distance, as much earth as can be kept about the roots should be left undisturbed. Above all, the roots must not be allowed to dry out. It is a good plan, when special care is possible, to wrap the roots of each tree with coarse canvas as it is removed from the ground. This protects them from drying and prevents the earth from falling away. If necessary, water should be added to make sure they are kept moist. While it is true that careful planting is necessary, it is also true that many more trees are killed by careless digging and neglect while out of the ground than by poor planting. This is particularly true of the conifers. The drying of the roots of a conifer, if only for a moment, is fatal. The resinous juice of these trees, if it once hardens, will prevent any further absorption of water, and the tree cannot live. A spruce or pine will often appear to live and even show some new growths, when in reality it is only using food material stored up in the stem and has not set up any connection with the soil. Living the first summer after transplanting is not a sure

sign that any tree is established, but less sure of conifers than of hardwoods.

The proper time of year for planting has been discussed as long as trees have been transplanted. In theory it should be possible to transplant at any time of the year, and in fact it is possible. With sufficient care a tree can be moved when in full leaf. In practice, however, it is advisable to do the moving when the risk is least and when, as a consequence, the care required is least. That makes it very inadvisable to move a tree during the season of growth. At any time between the cessation of the life processes in the fall and the renewal of life in the spring, trees may be moved with comparative safety. It is a common practice to dig trees in the fall, bury the roots in moist ground (heel them in) during the winter, and plant them the following spring. Species differ in their response to different treatment, and any peculiarities in this respect will be mentioned in connection with each. A very safe but difficult way to transplant a tree is to cut it out of the ground in the winter with a quantity of frozen earth about the roots and set it in its new location, taking care to stake it so that it will not loosen with the wind when the earth thaws in the spring. A few years ago I had a number of large Scotch pines moved in this way. The trees were from eight to ten feet high and not a single one was lost. Figure 13 shows one of these trees. The position of the third whorl of branches from the top shows the height of the tree when moved and all above that its growth since the moving. The tree was nine feet high when moved and

has averaged a foot a year in growth for the three years it has been in its present location. General practice seems to favor the spring as the most suitable time for both digging and planting, if other conditions permit, but pines, unless quite young, are not as readily grown as most trees.

Fig. 13. — A Scotch Pine, Transplanted in Winter. Brandon Normal School.

The hole to receive a tree should be large enough to contain the root system without crowding. It should be dug deeper than is necessary and partly filled in with good surface soil. All injured roots should be pruned away and the tree set firmly in its place. If it has been taken from the woods, it should be planted deeper than it grew naturally, but care should be taken not to bury the roots too deeply. Air is necessary and some of the roots should be near the surface. In light soil the planting should be deeper than in heavy clay land. Care must be taken to pack the earth firmly about the roots, leaving no spaces.

If the soil is at all dry, when the hole is about half filled with earth, a pail of water should be added and allowed to soak away. This not only wets the roots but helps to settle the earth. The hole may then be filled, carefully packed, and a layer of loose soil spread on the surface. It is a good plan frequently to loosen the surface around the newly planted tree with a rake, as it prevents evaporation.

But it is not always possible or convenient to secure trees for transplanting. If the purpose is to plant in large numbers, the expense and labor is too great. In such cases the trees may be propagated in the same way in which nature would do it. All trees produce seed and may be grown from seed. There are some quick-growing species, however, which start readily from cuttings and are generally propagated in that way.

In selecting seed, it is well to be sure it was raised in a climate not much less severe than the one in which it is to be grown. Seed collected in a more southern climate is likely to produce trees not entirely hardy when grown farther north. About five years ago there was sown, under my direction, a quantity of elm seed purchased through a dealer. A year later another sowing was made alongside this, the seed having been collected locally. Two years later a third sowing of seed collected in the province was made. The seedlings of the first sowing grow rapidly every year, but kill back to the snow every winter. At the time of writing there are young trees standing six feet high, more than four feet of which is last year's growth, and which is all dead. The seedlings from

the other two sowings are perfectly hardy and standing green to the top, or an occasional one killing back a few inches. The reason for this difference seems to be that the seed which was purchased was imported from the south. Removing the leaves from the young shoots early in the fall might allow the wood to harden, but such treatment could not be continued. The result is that the trees which are not hardy will have to be dug out. Some trees while perfectly hardy in a northern climate do not mature their seeds. Seed of basswood, collected in Manitoba, has always shown a very low percentage of germination when I have tried it. It is doubtful if the seed of either the hackberry or the silver maple grown in Manitoba will germinate, at least it would be safe to say that only an exceedingly small percentage will do so. At the southern end of Lake Manitoba there is an area where the hackberry grows, mixed with green ash and Manitoba maples. The trees are all fairly mature and there are no seedlings. Any that appear younger than the others seem to be shoots from old roots. They produce a limited quantity of seed, but it does not germinate, although the ash and maple seed produce abundance of seedlings.

At Portage la Prairie, and at many other places in the Red River Valley, the silver maple grows well. The tree seems perfectly hardy and produces seed. I have tried to germinate this seed and failed, and also failed to find any growing in cultivated ground quite close to mature trees. Seedlings of the Manitoba maple were growing in thousands, but most careful search failed to

reveal a single silver maple seedling, although a considerable quantity of seed had fallen on the plot.

It is evident, therefore, that in considering the suitability of a tree to any climate, we must consider not only the species, but where the individuals from which we intend to propagate were grown.

Seed which matures early, like the elm, should be sown the same year. The elm seed falls in June or early in July, and if kept over until the following spring before it is planted it loses greatly in germinating power. If sown at once a much greater percentage of the seed will germinate, and the seedlings get a fair start the same season. Any seeds of the broad-leaved, deciduous trees may be sown either in the fall or spring, but except in the case of those that mature early or those with a hard shell, there seems little in favor of fall sowing, unless it is more convenient. Seeds of maple and ash have been found to germinate well when sown in the spring.

Seed of all the broad-leaved trees is best sown in rows in well-prepared soil and the seedlings left for one or two years in the seed-bed. They should then be transplanted in rows from one to three feet apart according to size, and kept carefully cultivated until crowding makes it desirable either to transplant them to a permanent location or set them out in rows still farther apart. The best way to plant a young seedling is to make a hole with a stick, and after setting in the plant, fill the hole with water and press the soil firmly about it. The seedlings should be kept in a pail of muddy water to prevent drying out.

One of the chief difficulties in growing trees from seed is the tendency to become shrubby. Being exposed to light on all sides they branch from the ground, and the lower branches do not die and drop off as they would do in the woods. By having them somewhat crowded, and planting rows of the slower growers alternately with rows of poplars or willows, they will be shaded at the base and then grow taller and with clearer trunks.

The seed of conifers requires a different treatment. They are usually sown in seed-beds of well-prepared soil surrounded by a boxlike frame about ten inches high. It is sown broadcast over the surface and only slightly covered. It must then be kept moist and shaded in order to germinate. After the young plants are started, they need to be kept partially shaded. This is done by putting a covering made of laths nailed to the frame, the spaces between being about equal to the width of the lath. The seedlings may be left in the frames one or two years, according to the amount of growth made, and then pricked out in rows as was done with the seedlings of deciduous trees. The conifers need very much more care than the broad-leaved trees, and it is not advisable for anyone without some experience to undertake to grow them. Care should be taken that land on which conifers are to be raised should not contain alkali. While the white spruce will apparently stand a slightly alkaline soil, a very small trace of it will kill pines. It would not be possible to make any single general statement as to the kind of soil trees like best. There are trees suited to every soil condition from the

driest hill-top to a peat bog. As far as one might safely go would be to say that a rather light, well-drained soil suits the majority.

Some trees can be more easily propagated from cuttings than from seed. A cutting is a piece of young stem or branch about ten inches long, and generally less than three quarters of an inch in diameter. The wood should be fully matured, but not more than one or two years old. If the pieces are put into the ground and kept moist, they will take root and send up shoots which will develop into trees. They may be cut from the tree any time between the fall of the leaves and their coming again. Generally, for convenience, they are cut in the fall, tied in bundles and buried, to be used the following spring. If they are to be cut off trees convenient to the place of planting, they may be cut in the spring and used immediately. Often this gives the best results.

In theory, any plant should be capable of being propagated from cuttings. The stem can give off roots, branches or new stems and leaves, and these are the really necessary parts of a plant. All other parts are produced from these. In practice, only plants of strong vitality are thus propagated, as they are the only ones that will grow in that way without special care. Under a bell-jar in the laboratory, it is possible to root cuttings from many plants that could not be propagated in that way in the open. The only trees in our climate that have sufficient vitality to grow readily from cuttings are the willows and any of the poplars except the aspen.

Cuttings should never be allowed to lie around and dry out. If they are to be kept for any time they should be buried in moist soil, and it is always advisable to soak them well before planting. Moisture is the first essential in getting a good percentage of cuttings to root. In planting they should not be forced into the ground, but should either have a hole made for them or be leaned against the side of an open trench or furrow, the soil filled in about them and thoroughly packed. It is very essential that the soil be packed firmly against every part of the cutting. It is best to plant them on a slant, for then tramping the ground above them will pack it firmly. If they are placed vertically, the soil is often packed about the cutting only at the surface, leaving cavities lower down. They should also be planted deeply enough to secure a good moisture supply, and only a single bud should be left above the surface. An inch or an inch and a half is all that should appear. The soil should be well tilled and moist. When cuttings are being planted in large numbers they may be put six inches apart. When the young plants are large enough to crowd they should then be transplanted, giving them more room, just as would be done with seedlings.

The first essential in the care of growing trees is cultivation of the soil around them. This is much better than frequent watering. In a climate where the rainfall is plentiful they should require no watering, and, even in the prairie provinces where precipitation is normally low, they should need it only once in a while when the season is unusually dry. When watering is necessary some soil

should be removed about the base of the trunk, making a basin, and a pail or more of water poured about the roots and allowed to soak in. The surface soil should then be replaced and raked loosely about the base as a mulch to prevent evaporation. For newly transplanted trees, even

FIG. 14. — Trees Growing in Sod. Brandon Normal School.

in dry weather, once in two weeks should be often enough to water. Good cultivation of the ground, however, is necessary. Figures 14 and 15 show two rows of trees planted the same year within two hundred and fifty feet of each other. The rows run parallel, the slope of the ground is the same, and the soil as nearly identical as it would be possible to get it. They were planted and have always been cared for by the same men. The only way in which their treatment differed was that a lawn was made around those in Fig. 14, while the ground about the other row has been kept cultivated. No trees died in the row

where the ground was cultivated, while fully half the other row has been replaced. The largest cottonwood in the row in the lawn has a diameter now of about three and one-half inches, while those in the other row will average seven inches in diameter, measured one foot from the ground. The elms in Fig. 15 have doubled their average diameter

FIG. 15. — Trees Growing in Cultivated Soil. Brandon Normal School.

since planting, while only one elm of the original planting remains in the other row. The cultivation not only preserves the moisture but allows air to enter the soil, and this is very necessary for the life of trees.

After watering and cultivating, the next most important point in the care of trees is pruning. Not only should all shoots from about the roots and along the trunk be carefully pruned off, but the crown of the tree should be trimmed to suit the location and trained to a symmetrical shape. Care should be taken that no long weakly branches de-

velop, which are likely afterwards to break off, either by weight of leaves or by the wind, and leave unsightly and dangerous wounds. All branches should be cut off close to the trunk with a clean cut, so that it does not split with its weight and the split run down the trunk. To prevent this it is a good plan to make first a cut with the saw from the underside of the branch and a little distance from the trunk. This should be made as deep as possible until the branch binds on the saw. Then a similar one should be made on the upper side, a little farther from the trunk. By doing this any split that starts from the second cut is arrested by the first, and a short stump of the branch is left which may then be sawn off close to the trunk without danger. Whenever a large branch has been removed, the wound should be coated with paint or tar to prevent water getting into it and setting up decay.

The treatment of trees for fungous diseases of any kind is not an easy matter. Usually it is better, in the interest of surrounding trees, to sacrifice one that shows any tendency to fungous growths than to try to cure it. If all decayed parts are kept carefully pruned away and all wounds treated with tar or paint so that wet cannot get in, fungous growths should not give trouble. There are cases where decay attacks a tree locally, and, if left untreated, it would spread and destroy or disfigure it. If it is particularly desirable to prolong the life of a tree thus attacked, it is not difficult to remove all the decayed wood, treat the wound with hot tar or some antiseptic which will not soak into the green wood and injure it, and then fill the cavity

with a mixture of Portland cement and sand in proportion of about one to three. This should be mixed with water to make a stiff mortar, carefully packed into the cavity, and left smooth on the surface but not projecting. After the cement has set, it is as well to paint the outside to prevent it from absorbing the moisture. The new wood will form around this and in a short time close over it, and the tree may live for years. Figure 16 shows a poplar tree that was attacked by a fungus which had caused a decayed strip about two feet long and from one to three inches deep. As the tree was needed in its location until the adjoining elms grew larger, it was decided to try this "tree surgery." The wound is almost covered and the life of the tree has no doubt been prolonged.

FIG. 16. — A Russian Poplar Which Has Undergone a Surgical Operation. Brandon Normal School.

Insect pests are so numerous and so varied that to give many detailed directions would be beyond our present limits.

It may not be out of place to repeat that the danger from this source is much lessened if too many of the same species are not planted together. For purposes of treatment, insects may be divided into two groups, — those that injure trees by eating the foliage and those that pierce the outer skin of the leaf and suck the juices. The eating insects include the larvæ of a great many moths, butterflies, flies and beetles, but they may all be treated in the same way. Insects are very susceptible to arsenic poisons, of which the best known is Paris Green. Difficulty in procuring Paris Green has made it advisable to substitute arsenate of lead which is easily obtainable on the market now, either in the form of a powder or as a paste.

The sucking insects include the green aphis or plant louse, the woolly aphis and all kinds of scale insects. These names do not apply to single species but to types, each type including a large number of species. They must be treated with a spray which kills by contact, and the best, or at least cheapest, is made by forming an emulsion of coal oil and soap. The following extract from the report of Mr. J. M. Swaine of the Entomological Branch of the Department of Agriculture, Ottawa, gives very clear instructions for the making and use of the sprays.

"Lead Arsenate. Leaf-feeding insects of all kinds are usually best controlled by poison sprays. Lead arsenate is one of the best of these for use on shade-trees; its initial cost is somewhat higher, but it adheres to the foliage longer, and does not often burn the leaves when used at the ordinary strength. It is usually sold in the form of a paste, and should be worked up

in a small amount of water before being diluted. For general spraying against leaf-feeding insects, two pounds are mixed with 40 gallons of water; but for bad infestations of canker-worms, especially when the caterpillars are more than one-half grown, three or four pounds to the barrel of water should be employed.

"Lead arsenate is also used in the form of a powder. One pound of the powder will do the work of about two pounds of the paste.

"For use in small quantities:

Lead arsenate	1 tablespoonful
Water	1 gallon

"Paris Green is used at the rate of four ounces mixed in 40 gallons of water for general spraying against leaf-feeding insects. When a stronger mixture is required the poison may be increased to five ounces in 40 gallons. There must always be added at least as much freshly slacked lime as Paris Green to prevent burning the foliage, and the spray mixture must be kept well stirred while spraying is in operation.

Paris Green	4–5 ounces
Fresh lime	½–1 pound
Water	40 gallons

"For use in small quantities:

Paris Green	1 heaping teaspoonful
Mixed in water	3 gallons
Freshly slacked lime	3 ounces

"Kerosene or Coal Oil Emulsion; a very effective spray mixture for the control of plant lice, and other sucking insects. It must wet the insects in order to affect them, therefore the application should be thorough.

"One half-pound of hard soap is shaved fine into one gallon of hot soft water and stirred until dissolved. Two gallons of kerosene (coal oil) are then added and the mixture immediately churned violently until a thick, creamy emulsion is produced. This churning is best done with a bucket pump, putting the nozzle back into the bucket. The stock emulsion which is obtained when the mixture is properly made, will keep for months if covered from the air. For use on plant foliage it must be diluted with water at the rate of one part of the stock solution well mixed in from 9 to 12 parts of soft water.

FIG. 17. — Force Pump for Spraying Trees.

"Stock emulsion:

Laundry soap	½ pound
Soft water (hot)	1 gallon
Kerosene (coal-oil)	2 gallons

"Diluted spray:

Stock solution	1 gallon
Water	9 to 12 gallons as required

"Whale-oil or Fish-oil is used for the same purpose as kerosene emulsion. It may be employed against plant lice at the rate of one pound dissolved in from four to six gallons of water. Its unpleasant odour makes this insecticide less desirable for use on shade trees.

"Tobacco Extracts. Several valuable preparations of nicotine may be obtained from dealers in insecticides. "Nikoteen" and "Black Leaf 40" are among the best of these, and are very effective in controlling plant lice. Soap should always be added to the diluted spray at the rate of about one pound to forty gallons."

A spray pump will be necessary for their application and if much work has to be done, such as the spraying of the trees on the streets of a town, then one driven by a gasoline engine will be necessary. There is a great variety of these pumps on the market and they may be procured through any hardware merchant or seedsman. The cheapest to be effective for trees is a force pump to be attached to a barrel.

CHAPTER VIII

THE TREE PLANTATION ON THE PRAIRIE FARM

A DISTINCTION must be made between growing a plantation and growing trees. In tree growing the purpose is to secure the highest development of the individual. The trees are set out singly, or in groups or rows, but left sufficiently far apart to prevent one from interfering with the growth of the other. When a plantation is desired it is the grove as a whole that must be considered. It may be that certain trees will not be able to reach their best growth. In the interest of the whole grove and the use to which it is put, the individual tree may be sacrificed. If one wishes a row of fine trees, it is necessary to cultivate the ground thoroughly until the trees are well grown. In a plantation, however, the purpose is to produce a ground cover as soon as possible. This means that the ground is so shaded that the growth of weeds stops for lack of light. Perhaps the plantation's worst enemy is grass, and only a thorough ground cover will kill it or prevent its growth. Cultivation is necessary until the cover is sufficient and then it may cease.

Then, too, if good trees are desired it is necessary to prune them. The trunk must be kept clear of branches, and the crown shaped to fit its location. The plantation

requires no pruning. The lower branches help to cover the ground and in that way keep it moist, so that cultivation ceases to be necessary. The trees should also be close together, not more than five feet apart each way. Crowding shades them toward the base and makes them grow upward for light. This gives length of trunk, which is desirable for some of the purposes for which plantations are grown. The lower branches soon cover the ground when the trees are close together, and these remain until the crowns provide cover, when they die off for lack of light. This self-pruning provides for clearing the trunks of the lower branches and produces the long, clear, cylindrical trunk so characteristic of the forest tree. In short, the plantation is but a miniature forest grown in a convenient place for the use of a single family.

The value to be derived from a tree plantation on a prairie is easily seen. We all know how the wind sweeps over the Canadian prairies. In winter its force is increased by the driving snow which travels along the surface, and, even on days of apparent calm, is constantly filling tracks or blotting out landmarks. To check the sweep of this wind and to afford a shelter in which the farm buildings may be located is the first value of a plantation and by no means its least. It also affords protection for gardens or pastures which it may be desirable to shield, and at times may protect the grain crops from summer storms. Besides, a grove sufficient for shelter will also furnish considerable valuable material. The natural growth will supply fuel for the farm home, material for fence

posts and timber for any rough temporary work about the farm. While it is not desirable that good farm land be turned to forest to any considerable extent, yet to so use enough for a wind-break would not be out of place. As a rule the rougher parts of the farm offer the best building sites. Water is more easily found on a gravelly knoll than on the unbroken level. An irregular surface affords better drainage and generally greater natural beauty than level land. So if the more broken parts of the farm were chosen for building sites and clothed with good groves of trees, it would meet all the requirements of beauty, service and economy.

The only preparation of the ground which will be sure to give satisfaction is summer fallow or its equivalent. The planting being on a larger scale than when it is for purely decorative purposes, it is not possible that the same care can be given. It is, therefore, essential that the best possible preparation be made. Trees do not need a soil particularly rich in nitrogen, so that manuring the land before planting is not essential and may be injurious. The prairie soil is, as a rule, sufficiently rich in all the essential elements of plant food, but every means should be taken to increase the moisture supply. In the summer fallow the greater part of the moisture of the previous year has been retained and this makes the best preparation. If it is necessary to plant on newly broken prairie it should have been prepared the year previous by breaking and back-setting, with the addition of a deep ploughing in the fall. The object is to make as deep a bed as possible to absorb

and hold the moisture. Frequent cultivation the previous summer is essential for this purpose. Stubble land is not good for tree growing. The grain crop of the previous year has taken out a great deal of moisture, and the ploughed-down stubble is apt to leave cavities in the soil which hasten its drying out the next year. Garden soil or land on which a root crop has been raised is next best to summer fallow.

As the number of trees required for a plantation is large, the only material which can be used, without making both cost and labor too great, is seedlings or cuttings. These may be easily raised by any farmer, and a small nursery plot for the purpose would soon furnish all that is necessary. A few trees of willow, cottonwood, balm of Gilead or Russian poplar would furnish abundance of cuttings. These could be started in the nursery plot and transplanted to the plantation after the first or second year. In the plantation, as in all other cases, it is best not to trust all to a single species.

In spite of the fact that a small nursery plot on the farm would pay well both in material and satisfaction, few farms have one. In order that at least a limited supply may be available to any farmer who will put his land in proper condition, a nursery has been established by the Forestry Branch at Indian Head. Material may be secured from this source, but the purpose is to develop power on the part of the farmers to help themselves, rather than be a constant help to them. The following extract from one of the reports will make this position plain.

"A limited number of trees and cuttings are sent out each season from the Nursery Station at Indian Head, permitting on an average distribution of from 700 to 800 trees to each applicant, in two successive seasons, making a total of from 1400 to 1600 plants. Beyond this the farmer must rely upon his own resources for further developing his plantation. Planting material may now be purchased at reasonable prices from common nurseries operating in the West, or the farmer may quite easily grow his own stock from seed or cuttings taken from the older belts of trees."

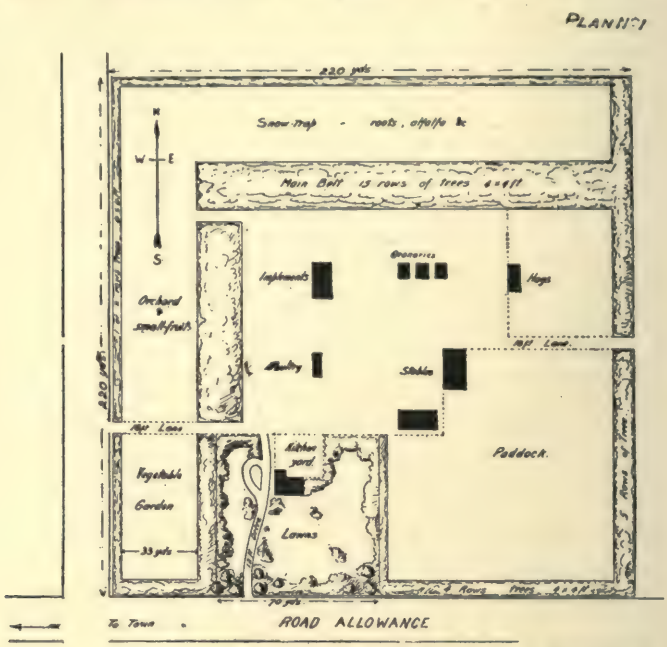
In considering the plan of planting for the protection and comfort of the farmer's home on the prairie, two or three things should always be kept in mind.

1. The first purpose of the planting is to furnish shelter, and therefore the shelter belt should always be on that side of the buildings which will protect them from the prevailing winds. Those from which shelter is most needed are from the north and west, so the tree belts should be on the north and west sides of the building site.

2. Snow piles in very high behind any wind-break and is likely to be a serious source of inconvenience about buildings. To prevent this the wind-break should be far enough away to allow the snow drift to form between it and the nearest building. At least one hundred feet should be left to catch this drift and then no inconvenience of snow about the buildings will result. Many people have been prevented from planting about the house because of the fear of snow piling too high.

3. In a broad belt, which would be necessary if planting were done for furnishing material as well as shelter, there

is danger of an immense drift forming in the middle of the grove. The snow from the prairie will lodge there until



Courtesy Forestry Branch, Interior Dept.

FIG. 18. — Plan of Farm House and Grounds.

the weight will break down the trees. While snow in moderate quantities is a good protection, it will do great harm where it piles so deep. If the young trees are not broken down, they will be so bent that many of them will never again assume an upright position. To prevent this a few rows of trees should be planted about one hundred feet outside the main grove. This will form a trap where

the snow will pile and thus protect the trees in the grove. It also forms a double protection to the house against

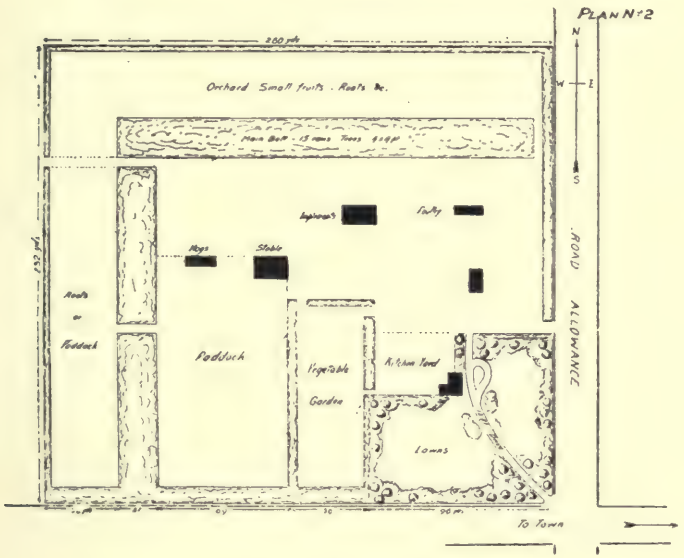


FIG. 19. — An Alternate Plan.

drifting snow, and the space inclosed may be used for garden or pasture.

CHAPTER IX

CANADIAN FORESTS

THE forests of North America are found in three main groups: the great eastern forest, stretching from the Atlantic westward to the Mississippi and well past the Great Lakes; the Rocky Mountain forest, including not only the wooded slopes and valleys of the Rocky Mountains themselves and their foothills, but also numerous smaller and mostly parallel ranges with their intervening valleys; the coast forest, covering the shores of the Pacific and extending inland up the river valleys and covering the mountain ranges nearest the coast. These regions are more or less perfectly divided by treeless tracts and are somewhat sharply distinguished by the species of trees they contain. The level grass plains, or prairies, separate the two former, while a dry and more or less treeless region lies between the Rocky Mountains and the Pacific coast. Farther south, this forms an arid desert, but desert conditions do not extend as far north as Canada. On the north these three wooded belts are united in an unbroken stretch, reaching across the continent and extending northward to and beyond the Arctic Circle.

The Canadian forests include the northern parts of these three distinct and parallel wooded belts, along with the

great northern forest which unites them all. The grass plains extend northward into Canada, dividing the eastern and Rocky Mountain forests as far north as the Saskatchewan river, but the Rocky Mountain and the Pacific coast belts are not so completely separated. The desert of the south does not reach Canada, but there is a "dry belt" in southern British Columbia, lying between the Selkirks and the Coast Range, which is in reality an extension of the southern desert. This dry belt is not by any means an open plain, much less a desert, but growth is less luxuriant than it is either east or west of it, and some tracts are almost treeless. Then, too, some of the species found there are not found in the regions of more abundant rainfall. In the northern part of the province this separation disappears, and the two belts merge into one great forest stretching from the Rocky Mountains to the coast. This is perhaps the greatest and most valuable block of timber in the northern hemisphere to-day.

At the extreme northern edge of forest growth only spruce and tamarack are to be found. An irregular line drawn from Fort Churchill on Hudson Bay to the mouth of the Mackenzie river, and a similar line from the east side of the bay at the same latitude to Ungava Bay, mark this most northern limit, and leave only a comparatively small part of the continent west and north of Hudson Bay which is quite treeless. Next to these hardiest species, the tree which grows farthest north is the canoe birch, followed closely by the poplar and the jack pine. The forest does not become densely wooded until we reach the

range of the balsam fir, which is marked by a line drawn from the southern extremity of James Bay northwesterly to the Yukon river, where it enters Alaska, and northeasterly so as to include almost the whole Labrador peninsula.

On the eastern half of the continent, these species are joined farther south by the best and most popular of all the cone-bearing trees, the white pine. This tree, with its intimate associates, the red or Norway pine, the hemlock, and the white cedar, soon almost replace the others, forming the immense pine woods of eastern Canada and the northeastern States. The white pine has been ruthlessly sacrificed to the greed and carelessness of man, until it is doubtful if any primitive growth now remains. A great deal of the area which it formerly occupied, however, is unfit for cultivation, and let us hope that man will in some measure undo this wrong by seeing that it is properly stocked with this king of the great pine family.

Farther south, the pines and hemlocks are gradually replaced by the broad-leaved hardwoods — beech, maple, basswood, elm and ash — with many other less plentiful species.

West of the Great Lakes the hardwood forests are not found. The prairie, fringed by a wide border of mixed timber and grassland, extends northward to meet the spruce woods — poplar, spruce and tamarack prevailing. In places, along river bottoms or on sheltered hillsides, groves of green ash, bur oak, Manitoba maple and white elm are found, but while these growths sometimes cover

considerable areas and are locally important, they do not form the type. They are confined mostly to Manitoba and southeastern Saskatchewan, although the Manitoba maple and the green ash extend their range well across the prairie. Throughout the whole prairie region the tree most frequently found is the aspen, or, as it is most commonly called, the "white poplar." In fact, the names white and black poplar have become so universally associated with the aspen and the balsam poplar respectively, that it seems useless to protest. These are undoubtedly local popular names, and as such must be recognized.

Of the three prairie provinces, Manitoba has the greatest proportion of forest. On the east side of Lake Winnipeg, extending northward to Hudson Bay and westward from the lower end of the lake, is the region of the spruce. This was formerly well wooded, but unfortunately has been much injured by fires passing over it during dry years. From the age of the present trees, it appears that about eighty years ago and again about forty years ago, there were fires which devastated vast tracts of country, while smaller conflagrations have occurred from time to time. Only on islands and in locations protected from fire are specimens of the primitive growth. Here, in places, trees of a diameter of 24 inches show the possibilities of the region, although the general stand over areas previously burned is still too small to be marketable. As the greater part of this region is unfit for cultivation, it is evident that its greatest value will be as a forest. If it can be preserved until the trees are matured, and cutting is then done under

proper regulation, it is capable of producing permanently a large supply of valuable timber.

Other wooded regions of Manitoba, although less extensive, are not less important, and the following quotations from the published report of an address by the Director of Forestry for Canada refers briefly to some others: "Along the valley of the Red and Assiniboine rivers was a mixed forest of elm, ash, oak, basswood and ash-leaved maple, where trees were found ranging to 24 inches in diameter. Rising like islands from the agricultural plains, tracts like the Turtle, Riding, Duck, and Porcupine Mountains bore forests of oak, ash and poplar in the Turtle Mountains, and of spruce, jack pine, oak, elm, ash, poplar and ash-leaved maple in the others. The character of the virgin forest may be seen from the following extract from a report of explorations made by Professor Hind on the 8th of November, 1858: 'I beg to subjoin the circumference, five feet from the ground, of a few trees within fifty yards of our camp on the Riding Mountains: — Aspen, 4 ft. 6 ins., 4 ft. 6 ins., 4 ft., 5 ft.; White Spruce, 7 ft. 3 ins., 5 ft. 6 ins., 6 ft. 6 ins., 6 ft.; Birch, 3 ft. 6 ins.; Poplar, 4 ft. 9 ins., 4 ft. 6 ins. These trees represent, as far as observation permitted, the general character of the forest on the summit plateau of the Riding Mountains.'"

This description would apply to the other prairie provinces with but slight modifications. The river valleys are more or less completely wooded, as are also a number of isolated elevations such as Moose Mountains, Cypress Hills, Wood Mountain, Touchwood Hills and many similar

districts. Besides this, large stretches of the plain are either completely wooded or parklike, groves and open prairie mixed. Going north the proportion of wood increases, until the whole country is covered. The prairie, even mixed with woodland, does not extend much beyond the north branch of the Saskatchewan, except a small area in the valley of the Peace river. However, the species change. The oak extends scarcely beyond the western borders of Manitoba, while the white elm follows the river valleys a little farther west. The green ash is found in southern Saskatchewan and as far west as the Cypress Hills, while the Manitoba maple ranges northward and westward almost to Edmonton. In the northern region the conifers prevail, spruce being the most plentiful; but poplar, particularly the aspen, is found everywhere. Sometimes, it forms thickets of slender saplings; at other times, forests of lofty trees fifty feet high and up to two feet in diameter. It is the all-prevailing wood of the prairie.

In western Alberta, the forest of the foothills gradually passes into the conifer type of the Rocky Mountains. British Columbia is the province of conifers. The heaviest timber is found in the coast region where the rainfall is most plentiful, and the lightest in the somewhat dry interior. The species are mostly different from those found farther east, but the trees reach a size unknown anywhere else in Canada. Almost solid forests of Engelmann's spruce are found in the valleys and on the mountain sides of the Rockies, giving way in places to lodgepole pine or Douglas fir. In the dry interior the yellow pine is most

common, while along the coast are found the Douglas fir, the giant cedar and the Sitka spruce, all of gigantic size. This constitutes the most extensive and perhaps the most valuable conifer forest in the world to-day.

To one who thinks of the causes of things, it is a source of constant wonder just how and why forests came to be distributed as they are. Many guesses have been made in attempts to explain particular instances, but only wide knowledge combined with good judgment will prevent mistakes. Such knowledge has been or is being gradually built up. The geologist, by examination of impressions of leaves and other such remains found in the rocks, can tell us what plants have occupied any territory in past geological ages. The botanist can tell what the natural conditions must have been where these plants lived, and the explorer can make plain the present conditions. Putting all the facts together we are led to the conclusion that existing forest conditions depend upon three main factors: (1) The natural conditions, including climate, soil, moisture and elevation; (2) The order in which species of trees spread their seed to new areas and thus get possession; (3) The power of species to contend with each other in the struggle for existence.

We now know that at one time — it matters not to us how long ago or by what name the period is known — great forests of trees, very similar to those which now grow much farther south, extended north beyond where forests of any kind are now found. We know further that these forests died out, and the northern part of the continent

became covered with an immense glacier which reached south, in many places well beyond the international boundary; and we also know that in time this ice disappeared, and that much of the territory occupied by it is again covered by forest. These changes did not come suddenly. This ice field withdrew gradually, leaving a lake along its southern border. As the ice receded still farther, this lake filled up with moss, forming peat bogs. Gradually these became dry enough to support other plants. First the bushes of the heath family took possession,— Labrador tea, swamp blueberry and sheep laurel perhaps most in evidence, with cranberries creeping in the moss. Then came the trees. The spruces and tamarack were first, because they grow when the ground is too wet for other species. These were closely followed by the white birch, aspen, balsam poplar, jackpine and balsam fir, and in that order. Then might come the white and red pines, hemlock and cedar. Trees follow this order partly because of the condition of the soil, partly because of the influence of climate, and partly because of the power they have to distribute their seeds and thus gain possession of new territory.

Where the white pine and hemlock are found, there will be various kinds of hardwoods as well. The number of species now rapidly increases, and the struggle of tree against tree for light, air and moisture becomes severe. Gradually the pines are overcome, and the forest becomes almost exclusively hardwood, the conifers holding their own only in certain vantage points, such as swamps, hills or sandy plains, where conditions favor them. Thus has

the forest marched northward. The order and procedure is true, not only of the eastern forest where the merging of the conifers and hardwoods is complete, but also of the prairie region where the hardwood belt is replaced by open plain. It is approximately true also of the mountain section, except that the factor of altitude operates more strongly. Elevation produces much the same result as higher latitude, and the conifer forest persists, relieved to a large extent by physical conditions from the struggle with the broad-leaved trees. And who is going to say that the forest is not still moving northward? The barren lands of the north are barren, not so much because they are so far north, as because that is a stage through which forests pass. These lands may yet furnish their full share of our national wealth.

PART II

TREES

"I have just been visiting a tree I know." — THOREAU.

THE PINE FAMILY. PINACEÆ

"The dominant races come from the region of the pine."
— JOHN BURROUGHS.

MEMBERS of this family may be distinguished from all other trees by the possession of a resinous juice, needle-shaped evergreen leaves and fruit in the form of cones. It is true one of these features may sometimes be lacking. The leaves of the tamarack are not evergreen, the leaves of the cedar are more scale-like than needle-shaped, and the scales covering the seeds of the juniper are so fleshy that the fruit is more frequently called a berry than a cone. In spite of these exceptions, however, the statement is still true that the possession of these three features will place a tree or shrub in this family.

The family includes not only the pines proper, but spruces, cedars, tamaracks, hemlocks, firs and junipers, and its members are amongst the most valuable of all timber trees.

Although some of the members of the family are low and shrub-like, the majority are trees with large straight trunks. The wood is strong, but usually soft and easily worked, while the resinous juice protects it from decay. When land is being cleared the hardwood stumps soon rot, their decayed roots mixing with and forming part of the soil, but pine stumps must be dug out, for the resin preserves the wood so that they rot very slowly. Almost all the timber used for buildings, bridges,

fence posts, telephone and telegraph poles, and railway ties is obtained from trees belonging to the great pine family.

The juice also is valuable. It furnishes resin and turpentine and was formerly the source from which tar and pitch were obtained, but these substances are now extracted from coal.

No trees have been so extensively used by the human race as the pines and cedars, and none have been so often mentioned in history and poetry. The cedars of Lebanon furnished the timber used in the erection of King Solomon's Temple, and in constructing the ships in which the early Phœnician sailed westward past the Pillars of Hercules; it was among the pines on Mount Ida that Œnone mourned for Paris; Horace wrote an ode to the pine tree in his garden, and Scott used the pine as the crest of Clan Alpine.

I. The Pines

Genus Pinus

The pines are all evergreen trees, although sometimes on high mountains they are so reduced in size as to be little more than shrubs. They have long needle-shaped leaves which always grow from the branch in little clumps or fascicles surrounded at the base by some small dry scales. These leaves or needles are from one to eleven inches long and the number in a fascicle varies from two to five.

In young trees the bark is smooth, thin, and often greenish in color, but as the trees get older it becomes thickened and much broken by furrows, while the outer part easily drops off in scales. The bark of the mature tree is brown, gray or tinged with red.

The wood in some trees is soft, white and easily worked; while in others it is reddish, and rather hard and brittle, owing to the large amount of resin it contains.

The cones take two or sometimes three years to mature, and

are usually more or less curved. They consist of woody scales closely overlapping each other, the exposed tip of each being much thickened. Each scale, in mature cones, covers a naked seed which is furnished with a somewhat broad wing.

The pines are widely distributed throughout the world in the rich soil of river valleys, on sandy and barren plains and exposed mountain slopes. As the young trees do not stand shade well, the hardwoods almost always crowd them out of the more favored locations, so that the pine forests of the present are generally found in sandy or mountainous regions where their competitors do not thrive. The more southern parts of eastern Canada formerly supported extensive pine forests, while the mountains of the west are still largely clothed by these splendid trees.

"The tremendous unity of the pine absorbs and moulds the life of a race. The pine shadows rest upon a nation. The northern peoples, century after century, lived under one or other of the two great powers of the pine and the sea, both infinite. They dwelt amidst the forests as they wandered on the waves, and saw no end nor any other horizon. Still the dark green trees, or the dark green waters jagged the dawn with their fringe or their foam. And whatever elements of imagination, or of warrior strength, or of domestic justice were brought down by the Norwegian or the Goth against the dissoluteness or degradation of the south of Europe were taught them under the green roofs and wild penetralia of the pine."

RUSKIN: Modern Painters.

WHITE PINES

Trees with soft white wood and five leaves in the fascicle.

1. WHITE PINE. Pinus Strobus. Linnæus.

This is a large tree, often 250 feet high, with soft white wood, easily worked and much sought for by the lumberman. It is the most valuable timber tree of eastern North America and for a long time was practically the only source of building timber.

The leaves are long, bluish-green, and often arranged in tassels on new growth on the ends of the branches. The cones are long, very slightly curved and drooping, sometimes in clusters. They are mature in July or August of the second year.

Its range covers the whole of eastern North America as far north as Lake Nipigon and westward to the southeastern corner of the province of Manitoba. Owing to depletion by the lumberman and the fires which followed in his wake, there is very little, if any, of the original forest left; but throughout a considerable part of the range re-foresting by nature is going on rapidly. The forestry departments of the different provinces are now doing good work in lessening the waste by fire, and there is good reason to hope that at least a limited supply of the timber furnished by this valuable tree may be permanent.

FIG. 1.—White Pine.

"No other tree," says John Burroughs, "is so widely useful in the mechanic arts, or so beneficent in the economy of nature."

Recently this species has been attacked by a disease which has killed the white pines of Europe, and, if not checked, it will destroy all the pines with five leaves to the fascicle on this continent. The forestry departments of Ontario and Quebec, however, with the assistance of the Forestry Branch of the Dominion, are doing all that is possible to prevent this disease spreading, and we hope that a tragedy in tree life may be avoided, and that to future generations this noble tree will not be merely a tradition or a record.

2. WESTERN WHITE PINE. Pinus monticola. Douglas.

This is the species which is known as white pine in British Columbia and the Pacific Coast States. It so closely resembles the eastern white pine that for a long time it was regarded as

simply a western variety of Pinus Strobus. Although it is now considered to be a distinct species, the differences are not such as would be noticed by the ordinary observer. It is, however, a slightly smaller tree than the eastern species, but produces very much larger cones.

The timber is soft, white, easily worked and much used in construction. It has largely replaced the eastern white pine for building purposes through the prairie provinces. The increasing scarcity and consequent high cost of white pine lumber of all kinds is restricting its use to special purposes, the more plentiful red pine and fir supplying the greater bulk of construction material.

Fig. 2.—Western White Pine.

It occurs in southern British Columbia from the western slopes of the Rocky Mountains to the coast. It is usually scattered through the mountain forest of this region, and does not itself make up large forests.

Unlike its eastern relative this tree has been somewhat widely used for ornamental purposes, both in eastern North America and Europe. Its growth is slow but vigorous, and it has been found more suitable for transplanting to an eastern soil and climate than any other western pine.

3. Limber Pine. Pinus flexilis. James.

This tree, although a true white pine, does not closely resemble either its eastern or western relative. It is a short, often stunted tree, seldom more than sixty feet and often not exceeding forty feet in height. The leaves are about two inches long, stout, stiff and very dark green, growing on flexible branches. The bark of old trees is thick, deeply furrowed and dark brown, or sometimes nearly black. The cones are short

and stout, growing out horizontally from the stem or only very slightly drooping. They mature early in the fall of the second year.

The wood is light and soft, but close-grained and not so easily worked as that of the eastern white pine. It is pale yellow, turns reddish when exposed for some time to the air, and is not valuable as timber.

This is a Rocky Mountain species occurring on both the eastern and western slopes from Alberta and British Columbia southward, but its western and northern limits have not been clearly defined, as it is somewhat confused with the next species.

4. White-Barked Pine. Pinus albicaulis. Engelmann.

In many ways this tree resembles the preceding and is hard to distinguish from it. It is a mountain species extending up to, and sometimes forming, the timber line on the higher mountains. It is always stunted and at high altitudes may be a prostrate shrub.

The branches are short and flexible and often grow almost erect, giving the tree an irregular and shrubby appearance.

The leaves are dark green, about two inches long, stout, stiff, and slightly curved, usually grouped at the ends of the branches. The cones are about two inches long and somewhat globular, maturing early in the fall of the second year, although they grow very slowly during the first year. They are dark purple in color and stand out horizontally on the branches, from which they fall without opening. The seeds themselves are large and sweet and are said to be used as food by the Indians.

The bark on young stems is thin and almost white. On older trees it becomes thicker, especially at the base of the trunk, but is seldom more than half an inch thick. The older bark is finely grooved into small brown or whitish scales.

The wood is light brown in color, and while soft it is brittle

and has never been extensively used or much valued as a building material.

The range of this species is mixed with that of the preceding. The following extract from the report of Mr. T. W. Dwight to the Dominion Forestry Branch indicates about all that is known of them, as well as the confusion which exists both as to occurrence and identity.

"These two species of pine are found as scrubby trees on the poorest sites. Owing to their infrequent production of cones and the difficulties involved in distinguishing them, the exact occurrence of the two species was not determined. It is probable that white-bark pine alone occurs on the higher ridges in the mountains proper and that limber pine is mainly confined to the higher elevations in the foothills. Neither species reaches merchantable size except occasionally, nor is of great importance from the standpoint of forming a soil-cover on poor sites, since they are not aggressive enough in natural reproduction to bring about much practical benefit."

"Limber pine, under favorable conditions, reaches a size of 18 inches in diameter and 60 feet in height, but even then is very subject to having forked tops and crooked boles. Most of the limber, however, and all of the white-barked pine are stunted, and on exposed sites are reduced almost to creeping shrubs. The root system is rather shallow and the trees are subject to wind-fall, although mainly on account of the shallow soil and exposed site which they habitually occupy. Their capacity for resistance to climatic extremes is very great, as they are nearly always subjected to frequent frosts and severe storms. Their tolerance is small, probably less than that of lodgepole pine, and this factor is to a considerable degree responsible for their not extending their range to lower sites. The amount of cone production is very small in this region, and is the main reason for the small number of trees of these species. As the seeds are large, they will germinate on a moderately thick humus as well as on mineral soil."

YELLOW PINES

Trees with hard resinous wood and leaves in fascicles of two or three.

5. Bull Pine or Western Yellow Pine. Pinus ponderosa. Lawson.

The yellow pines closely resemble the red pines in their hard resinous wood. They are sometimes classed with the latter, the whole group being called pitch pines. In Canada they are represented by this single species.

It is a large tree, often more than two hundred feet high, with short stout branches, much forked and sometimes drooping. The young growth is strongly aromatic.

Fig. 3.—Yellow Pine.

The leaves, in fascicles of two or three, are from three to eleven inches long and tufted on the ends of the branches. They fall about the end of the third year. The bark is thick and deeply furrowed. On the older trunks the scales are large and reddish-brown, but on young trees they are smaller and almost black. The cones are nearly four inches long, and sessile, growing horizontally from the stem in clusters of three to five. They mature about the middle of the second summer and fall early, usually leaving some of the scales attached to the stem. The wood is light red, hard and resinous, but brittle. It is durable when not in contact with the soil or exposed to moisture, and is extensively used for various kinds of construction purposes.

This is a tree of the drier region of southern and central British Columbia, extending northward on the plateaus between the mountain chains to the south end of the Upper Arrow Lake on the east side of the Selkirk Mountains, and for some miles north of Ashcroft to the west of that range.

RED PINES

Trees with hard resinous wood and leaves in groups of two to the fascicle.

6. Red or Norway Pine. Pinus resinosa. Solander.

The red pine is a tall, graceful tree, often rising to a height of one hundred and fifty feet, with a straight, somewhat slender trunk and pale reddish bark. The leaves are from three to six inches long, dark green, slender and flexible. On the older branches they are grouped in graceful tassels at the ends of the somewhat drooping stems.

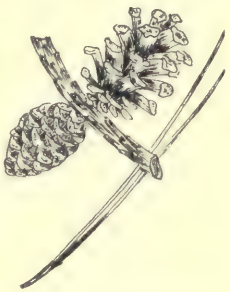


Fig. 4. — Red Pine.

The cones are about two inches long, horizontal, not at all or very slightly curved, and shiny brown at maturity. They open and shed their seeds early in the fall of the second year, but the old cones usually stay on the branch another season. The wood is reddish, hard, strong and resinous, arranged in very conspicuous rings. It is not as easily worked as that of the white pine, but on account of its great strength, straightness and freedom from knots, is very valuable as building material.

The range of this tree in Canada is identical with that of the eastern white pine, although it does not extend so far south. Its western limit is the southeastern part of Manitoba. Throughout this range it grows along with the white pine, the two often standing in mixed growths. It is easily distinguished from the latter by its more slender graceful trunk and reddish bark.

7. Jack Pine. Pinus Banksiana. Lambert.

This is a small tree, seldom rising above eighty feet and usually much less, being reduced almost to a shrub at its northern

limits. Its trunk is often short and stunted, but in thick groves may be straight and slender, and free from branches for about one-third of its length. The branches are long, and may either form a rather acute angle with the stem, or be given off at right angles.

The leaves are dark green, about one and a half inches long, stout, rigid and more or less curved. They are arranged somewhat loosely along the stem. The bark is thin, brown or reddish and thickly covered with irregular scales. The cones are sessile, not more than two inches long, and strongly curved toward the stem, owing to the greater development of the scales on the outer side. This unequal growth of the scales composing the cone makes it very oblique at the base, so much so that at times the stem appears to come out of the cone at the side. The wood is pale brown or yellowish-white, close-grained but light and weak.

FIG. 5. — Jack Pine.

The jack pine is a tree of the north. It seems to seek neither moisture nor uniformity of temperature, but reaches its best development on dry sandy plains exposed to scorching heat in summer and severe frosts in winter. Its range extends across northern Canada to Lake Winnipeg, and thence, northward and westward to the Rocky Mountains and Great Bear Lake.

As a timber tree it is valuable locally for fuel, posts and building logs. It is not sawn into lumber to any very great extent. It grows quickly and is easily propagated from seed, but the cones open only after being subjected to heat. Its rapid growth and rather shrubby form make it a tree which has good possibilities if used for ornamental purposes.

8. Lodgepole Pine. Pinus Murrayana. Balfour.

The lodgepole pine is a distinctly western species and usually a tree of the mountains. It is small, slender and graceful; seldom much more than two feet in diameter and rising at times to a height of one hundred and fifty feet. It has the habit of growing in dense groves unmixed with any other species. As many of these groves are made up of young trees, the trunks are tall and slender, more resembling the tamarack than other pines. These clean trunks, being of uniform size and very straight, formed the chief source from which the Indians of the west obtained poles for building their lodges, and hence the name.

Fig. 6. — Lodgepole Pine.

The leaves are yellowish-green, about two inches long, and are distributed along the younger stems. The bark is very thin, gray or brown in color, and covered by small, thin scales. The cones are about two inches long, usually in pairs, near the ends of the branches. They mature in the fall of the second year, but frequently remain on the stem another year, and while they sometimes shed their seed at once, they not infrequently remain closed and the seed has been known to retain vitality for twenty years.

This is generally a tree of the mountains and their foothills. It covers large areas of mountain slopes from western Alberta almost to the Pacific coast. It also covers a small area in the Cypress Hills in southwestern Saskatchewan.

In fact it was from this tree that the Cypress Hills derived their name. The French-Canadian voyageurs used the name cyprés for the jack pine of the east (*pinus Banksiana*). As there is a strong resemblance between the two trees, the lodgepole pine is also often called jack pine and hence cyprés or cy-

press. It was then very natural that the only hills in the whole prairie region on which the tree grows should be called Cypress Hills.

As a timber tree the lodgepole pine has considerable value, more owing to its clean straight trunk than to the quality of the wood. It is easily reproduced from seed, transplants well and grows rapidly. Some seedlings about a foot high were planted in the Normal School grounds in Brandon four years ago and some of them are now seven feet high and producing cones, early cone production being characteristic of the species. The habit of growing tall and slender may make this species of doubtful value for ornamental purposes, but it undoubtedly has qualities that commend it for reforestation of burned over areas. Its value is well indicated in the following quotation from the report of Mr. T. W. Dwight on the Rocky Mountains Forest Reserve.

"Locally this is commonly called jack pine, but the true jack pine (Pinus Banksiana) does not enter the region under consideration. Lodgepole pine is the most abundant tree of the region. In mature stands, it divides the area with spruce and other species but in the widespread second-growth stands it vastly predominates and so holds a very important place in relation to the future. It also has the distinction of producing the clearest and highest grade of lumber, although it is small in size. This is due to the form of the tree which has a long cylindrical bole, well cleaned of branches, and a small short crown induced by the intolerance of the species and its habit of growing in dense, uniform, even-aged stands. The bark is very thin, .2 to .4 in., comparatively smooth, with small scales or shallow ridges, and grayish in color.

"The manner of seed production is one of the most important of the individual characteristics of lodgepole pine. It is distinct, not only from the other genera but also from other species of pine except jack pine. The main points of interest are: first, the early age at which seed production begins; second, the quantity and comparative regularity of production; third, the persistence of the cones

on the trees; fourth, the slow release of seeds from the cones, resulting in an almost permanent locking up of a considerable proportion of the seed; and finally, the long retention of germinative capacity by the seed."

9. Scrub Pine. Pinus contorta. Loudon.

This is a low tree somewhat stunted and often irregularly shaped or apparently twisted.

It resembles the preceding species in many ways, particularly in the size, shape and location of its cones, its production of seed when very small — sometimes only a few inches high — and the long vitality of the seed itself.

It differs in having a much thicker bark, especially near the base of the trunk, and strong, hard, coarse-grained and resinous wood, as well as in its stunted growth. The resemblance, however, is sufficiently strong to induce some authors to consider them as merely different varieties of the same species.

Its range is along the Pacific coast extending inland to the western slopes of the Coast Range. Growing as it does where some of the largest and most valuable timber trees of the continent are very abundant, this tree cannot be said to have any economic value.

10. Scotch Pine. Pinus silvestris. Linnæus.

This is the common European pine transplanted to this continent. It closely resembles our red pine, except that the leaves are shorter and more rigid and the branches have little or no tendency to droop.

Fig. 7. — Scotch Pine.

It is widely grown for ornamental purposes in the eastern part of the continent, and also grows well on the prairie. It stands heat, cold and drought without apparent injury, can be reproduced

readily from seed, grows rapidly when young and transplants well for a pine. Although not particularly graceful when grown by itself, it can be used to advantage when grouped with other trees, particularly to form a sky-line.

II. The Spruces

Genus Picea

The spruces are evergreen trees found in the cooler parts of the Northern hemisphere. They have tall, straight, gradually tapering trunks and small horizontal branches regularly arranged in whorls, sometimes drooping. When young and uncrowded they are conical in form, but when older or crowded have straight naked trunks and cone-shaped tops. The leaves are short, rigid, sometimes sharp-pointed, and pretty evenly distributed over the branches from which they stand out almost at right angles. The cones are rather small with two seeds at the base of each scale. They mature and shed their seeds in one year but the old cones often cling to the stems for several seasons.

They are among the most valuable timber trees of northern latitudes and are much used for ornamental purposes. Their symmetrical conical form, dark green or bluish-green foliage and rapid growth make them particularly desirable. They can be easily reproduced from seed, and with proper care can be transplanted easily.

1. White Spruce. Picea canadensis. (Miller) B. S. P.

The best known, most widely distributed and most highly prized member of this genus is the white spruce. It is a lofty tree, reaching at times a height of one hundred feet, with a base diameter of three feet. The trunk is clean, straight and gradually tapering, almost mastlike in size and proportions. The bark is brownish-gray, about half an inch thick, and much

broken into irregular scales, but not deeply furrowed. The branches are stout and stiff, with a slight curve upward, and the branchlets, though not flexible, are often drooping. In young trees, grown in the open where the light can reach them from all sides, these branches may extend in regular whorls from quite close to the ground, forming an almost perfect cone.

The leaves are about three quarters of an inch long, stiff, rather sharp-pointed, and, except when crowded or where the light is not good, are pretty evenly distributed around the stem. In young shoots they are light bluish-green, the new growth thus forming a pleasing contrast with the more sombre foliage of previous years. At times these leaves have a very distinctly skunk-like odor, which has given rise to the local name of skunk spruce in some places.

Fig. 8. — White Spruce.

The cones are sessile or nearly so, from two to three inches long, tapering gracefully to both ends. When young they are pale green or reddish but become shiny brown when mature. They shed their seeds early in the fall and usually drop off during the winter.

The wood is soft, white and easily worked, but not very strong or durable when exposed to the weather. It is extensively used as lumber and pulpwood, which makes this spruce one of our most valuable forest trees.

This is the evergreen of the prairie, where it seems to prefer dry, sandy soil, although it also grows in moist places. It is widely distributed all across Canada and is extensively cultivated for ornamental purposes.

Alberta Spruce. Picea albertiana. (S. Brown).

The western white spruce of Alberta and British Columbia has always been regarded as simply a western form of the or-

dinary white spruce. Recently it has been described as a distinct species under the name *Picea albertiana*, and is said to have shorter and more globular cones than the eastern tree. Whether or not it will continue to be regarded as a separate species is still doubtful.

It is recognized by Rydberg in his "Flora of the Rocky Mountains and Adjacent Plains."

2. Black Spruce. Picea mariana. (Miller) B. S. P.

This is a companion of the white spruce both in appearance and distribution, the two being frequently confused. It is somewhat smaller than the preceding, with rather shorter leaves. The branches are short and drooping, with often a slight upward curve at the tips. The lower branches die more readily than in the white spruce and often fall off on one side or in patches along the trunk, leaving only a comparatively short, perfect cone at the top. To the person well acquainted with these two trees their general appearance will enable the two species to be distinguished even at a distance. For those who require a more minute point of difference the cones furnish the most distinctive feature. In the black spruce these are less than an inch long and become almost globular when the scales open to discharge the seed. Unlike the white spruce, the seed is shed slowly and the cones remain on the stems for years, the older near the base of the stems and the newer towards the apex. The cones of different ages sometimes form dense masses on the upper branches and make an unmistakable point of identification.

Fig. 9. — Black Spruce.

This tree is distributed all across Canada and extends far northward. In the more southern part of its range it grows only in cold sphagnum bogs, but in more northern regions is

also found on the rocky and moss-covered hillsides, where it joins with the white birch, aspen and balsam poplar to form the greater part of the forest.

The wood is soft, weak and yellowish-white in color, and is not valuable as a timber. It is extensively used as pulpwood and in some places is sawn into lumber, while in the northern forest it is a valuable source of fuel.

The broken and irregular appearance of this tree makes it unsuitable for ornamental purposes.

3. Engelmann Spruce. Picea Engelmannii (Parry) Engelmann.

Engelmann's spruce is a tree of the mountains, where it forms dense forests. It is a lofty tree, often one hundred and fifty feet high, with a diameter of three feet or more at the base. The general average, however, is much smaller.

The branches are slender and spread in whorls from the base, but the lower soon die off, leaving a compact cone at the top, with only straggling drooping branches down the trunk. The bark is about half an inch thick, deeply broken into brown or reddish scales. The leaves are about an inch long, soft and flexible except at the tips, and are distributed evenly over the stem. Those on the fertile branches are often shorter and stouter. When bruised they have the disagreeable skunklike odor of those of the white spruce.

The cones are about two inches long and are produced in great numbers on the upper branches. They are green, with a tinge of red when young, but become brown when old. They drop off in the winter after having shed their seeds.

The wood is light and soft, yellowish-white, with sometimes a tinge of red. It is extensively used as lumber.

This species belongs to the mountainous regions of British Columbia and Alberta, reaching its greatest development in the Rocky Mountains. It forms the bulk of the spruce forest at Banff.

4. Sitka Spruce. Picea sitchensis. (Bongard) Carrière.

This is the largest of all our spruces, growing to a height of one hundred feet, with a diameter of three or four feet, but occasionally reaching a much greater size. The leaves are about an inch long and stand out almost at right angles to the stem. The bark is about half an inch thick, brown or reddish in color, and broken on the surface into large loose scales. The cones are from two to four inches long, green and often tinged with yellowish-red when young. They fall off during the first winter. The wood is light brown or reddish, soft and straight-grained, and is a most valuable lumber. During the war it has been largely used in the construction of aeroplanes, its strength and lightness making it particularly suitable for that purpose.

Fig. 10. — Sitka Spruce.

This tree is found in moist, sandy or swampy soil along the whole coast line of British Columbia. As its range does not extend far inland it is sometimes called tide-water spruce. It has been transplanted with some success to Europe and eastern North America.

5. Colorado Blue Spruce. Picea pungens. Engelmann.

This is a beautiful and very variable tree, introduced from the mountains of the southwestern States. It grows rapidly and is easily recognized by the bluish green color of the leaves during their first year. It seems fairly hardy through the prairie region and is likely to be a valuable addition to the evergreens available for ornamental planting.

III. The Firs

Genus Abies

"I remember, I remember
The fir trees dark and high:
I used to think their slender tops
Were close against the sky:
It was a childish ignorance,
But now 'tis little joy
To know I'm farther off from heaven
Than when I was a boy." — Thomas Hood.

The word "fir" has been used with various meanings. It was originally the name applied by the Scandinavians to the Scotch pine, *pinus silvestris*. The term afterwards began to be used in a wider sense by the early herbalists until it was applied to all the true conifers. This led to confusion, and explanatory words had to be used to indicate particular types, and we hear of the pine firs, spruce firs and hemlock firs. In Europe the word is still used to apply, not only to the firs proper, but to the spruces as well. In America, however, it is seldom used except when applied to the genus *abies* or silver firs, so called on account of the color of the leaves on the under side. The one notable exception to this is the Douglas fir of the Rocky Mountains and the Pacific slope, which belongs to an entirely different genus.

The true firs, or silver firs as they are called in Europe, are tall, graceful trees, much resembling the spruces in general appearance. The branches are given off in uniform whorls, producing the most perfectly cone-shaped trees found in our forests, when they grow where the light can reach them from all sides. It is easy to distinguish the firs from the spruces by the leaves and bark. The leaves are longer and more flattened, especially on the older branches, dark green or bluish-green above and silvery-white beneath, with a twist at the base which

arranges them in two rows on the opposite sides of the stem, exposing the upper surface to the light. The bark is thin, smooth and sometimes whitish, and contains numerous blisters which, when ruptured, exude a sticky resinous liquid, which may often be found where it has hardened in streaks as it ran down the trunk. The presence of these blisters in the bark is a ready means of distinguishing the firs from any other of our cone-bearing trees.

1. Balsam Fir or Balsam. Abies balsamea. (Linnæus) Miller.

The balsam fir is one of our most graceful trees, its rich dark green foliage and conical shape making it a rare combination of beauty in both form and color. The leaves are dark green above and silvery-white beneath, not more than half an inch long on the upper cone-bearing branches but sometimes more than an inch long on the older sterile boughs. The cones are from two to four inches long, standing erect on the stem. They are a rich purple and very resinous, the juice often exuding as viscid drops on the young cones or remaining in dry hard masses on the old ones. The bark is densely covered with blisters and varies from thin, smooth, greenish or whitish in the young trees, to about half an inch thick and a rich brown on the older trunks.

Fig. 11. — Balsam Fir.

This tree grows on light, well-drained soil, wherever conifer forests are found across Canada to Alberta. It is replaced in the mountains by other species. It grows rapidly and has been extensively used for ornamental planting, but is now being largely replaced for that purpose by more vigorous and longer-lived species from western America and from Asia.

The resinous juice collected from the blisters on the bark is sold under the name of Canada balsam, and used in microscopic

work for making permanent mounts, and in surgery for application to wounds.

The wood is light and soft, pale brown or white, and is frequently sawn into lumber and used in making packing boxes.

2. Alpine Fir. Abies lasiocarpa. (Hooker) Nuttall.

This is a mountain species, closely resembling the balsam except in form. The leaves are light bluish-green, short, densely crowded and often standing almost erect, owing to the twist at the base. The branches are short, the lower with a tendency to droop. The whorls of branches are close together, owing to the slow growth of the tree, the whole tree thus presenting a very narrow and compact cone instead of the open broad-based cone of its eastern relative. The bark on young stems is smooth, thin and nearly white but becomes thicker on older trunks and broken into irregular reddish-brown scales. In color, size and form the cones closely resemble those of the balsam, and the wood is similar and little used for commercial purposes.

Fig. 12.—Alpine Fir.

The Alpine fir is distributed on the slopes of all the mountains of British Columbia and Alberta. At high altitudes it is reduced to a mere shrub, but at lower levels is a graceful and rather lofty tree. It has been little used in cultivation owing, no doubt, to its slow growth, but its compact, narrow, conical form makes it present a pleasing variation when mixed with other conifers.

The juice of this fir is also a source of Canada balsam.

3. Amabilis Fir. Abies amabilis. (Loudon) Forbes.

The name of this fir means *lovely*, and if a tree can be called lovely, it is well deserved. History does not record the fact.

but it must have been named by a woman. It is a lofty tree, with a straight trunk sometimes more than two hundred feet high, with a diameter of almost five feet at the base. The bark is gray or brown, thin and smooth on the younger trees and covered with large blisters, but on the largest and oldest trunks it is rough and as much as two inches thick. The leaves are flat and shining, dark green above but white beneath. On the older branches they are often an inch and a half long. The cones are large, as much as six inches long, dark purple and often indented at the point.

FIG. 13.—Amabalis Fir.

This magnificent tree is found in British Columbia on the western slopes of the mountains facing the Pacific Ocean, but it reaches its best development in the Olympic Mountains in the State of Washington where it forms dense forests. It is used for lumber, its wood being light brown, hard and strong. The lumbermen frequently but wrongly call it larch.

4. LOWLAND FIR. Abies grandis. Lindley.

This, too, is a large tree, even larger than the preceding. It grows to a height of almost three hundred feet, with a diameter of from four to five feet. It may be readily distinguished from the amabilis fir by its longer and softer leaves, the color of its cones and the character of the soil where it grows.

FIG. 14.—Lowland Fir.

Its leaves are about two and a half inches long on the older branches, green above and white beneath, and stand out almost at right angles to the stem in two distinct rows on opposite

sides. The cones are green and about four inches long. The bark varies from gray to brown, and from thin and smooth to thick and rough.

This is a tree of the lowlands. It is found in the moist flats and river valleys of Vancouver Island and southern British Columbia, where it grows to be a lofty tree with long, slender, drooping branches.

The wood is soft and light and but sparingly used for building and other purposes.

This is the most rapid grower of all the firs, but it requires a rich soil and moist climate with an altitude not much above sea level to attain its best development. It has been transplanted for ornamental purposes in Europe but is not much used in America.

IV. The False Hemlocks

Genus Pseudotsuga

This genus contains but three known species, one a native of Japan and the others of the western coast of North America. The word "pseudotsuga" is a combination of the Greek word meaning false with the Japanese name for the hemlocks. Surely here is the place where the East meets the West.

They are large conical trees in many ways resembling the firs. The bark, however, is thick and deeply grooved, and bears no blisters as in the firs. The cones are drooping on distinct stalks, each scale being in the axil of a bract longer than the scale. These bracts are two-lobed, forming a sort of fringe around the cone.

The false hemlocks may easily be distinguished from the firs by their bark and cones.

1. Douglas Fir. Pseudotsuga mucronata. (Torrey) Mayr.

"A big tree is nature's masterpiece. It has a strange air of other days about it, a thoroughbred look inherited from the long ago."
— John Muir.

No minute description is necessary to describe this, the giant of the Rocky Mountain forests. It is the largest and most abundant tree in a region where trees are plentiful and big trees are the rule. With a height of three hundred feet, it sometimes has a diameter of twelve or fourteen feet at the base, the bark being at times fully a foot thick. If growing in the open it may be clothed with branches to the base, forming a somewhat loose cone, the lower branches drooping. When crowded, however, the trunks are naked for fully two thirds of their length, standing like immense columns supporting the green roof of the forest.

Fig. 15. — Douglas Fir.

The Douglas fir can be described only in superlatives. It is not only the largest and most abundant, but the most valuable timber tree of western America. The wood is hard, strong and resinous, varying from light yellow to reddish, and may be either coarse or fine-grained. It splits easily and is rather hard to work, but where size, strength and endurance are required is without a rival. It is extensively used in all kinds of construction and also for floors and interior finishing.

This tree is distributed all over the mountain regions of British Columbia and Alberta south of latitude 51°, except in a narrow strip along the western coast of Vancouver Island and the coast of the mainland north of the Island. Along the Gulf of Georgia it grows right to the water's edge, both on the mainland and on Vancouver Island, but it does not seem able

to stand the winds from the Pacific. Over this region it frequently forms large tracts of dense forests, but reaches its fullest development in the states of Washington and Oregon.

As an ornamental tree it has been used with success in Europe, but not to any great extent in America outside of its natural range. It has recently been found that seeds ripened in the interior and at fairly high altitudes produce trees which are hardy in other parts of North America, and its wider use in parks and gardens may be looked for.

V. The Hemlocks

Genus Tsuga

The very word "hemlock" has an evil sound. One is unpleasantly reminded of the death of Socrates. The poisonous plant, from which the ancients obtained the historic "cup of hemlock," was in reality a kind of wild parsnip, and had nothing in common with the hemlock tree. The word hemlock is of old English origin and no similar word exists in any other language. How the same name came to be given to a poisonous herb of the parsnip family and a genus of large coniferous trees is one of the many unexplained and unexplainable things found in the distribution of names.

But even the hemlock tree has no good reputation. The eastern hemlock had an unpleasant habit of growing everywhere. It was omnipresent. No hardwood was so dense but some hemlocks could find a place; and no pine grove so pure that the hemlock dare not intrude. The wood would neither burn nor rot, and the knots were so hard they broke the woodman's axe. Even if by much chinking, and not a little swearing, a logheap of hemlock was persuaded to burn, it left the knots. These were too wet to burn and too resinous to rot; all that could be done was to dig a hole and bury them.

When the scarcity of pine made it necessary for the lumberman to resort to hemlock its evil reputation increased. The wood was so near the weight of water that it would scarcely float. If the riverman stepped on a hemlock log it promptly sank under him; and after a drive had been safely run down to the mill, the hemlock logs would all go to the bottom. The river-driver called them slugs.

No doubt much of the bad reputation of the hemlock was due to being always associated with the white pine. It suffered in the comparisons which were always being made. This is well illustrated in a woodman's story of their origin. It was said that when the beneficent Providence wished to bestow a blessing on man he made the white pine. His Satanic Majesty, however, would not be outdone. He too would show his power, and perchance increase his popularity, by making a pine tree. But when it was made it turned out to be a hemlock, and so shaky that he had to pin it together with knots.

This tree of evil repute does not extend west of Lake Superior, and the two species found in British Columbia have not had to bear comparisons with the eastern white pine, or the oaks, maples, hickories and walnuts of the eastern hardwoods. We need not be surprised, therefore, if the western trees bear a better reputation.

The genus has only eight members, four in America and four in Asia. There are no European hemlocks. The name "tsuga" is the Japanese name for two of their best timber trees. The genus is easily distinguished by the rough, reddish-brown bark, leaves usually arranged in rows on opposite sides of the stem, and small drooping cones made up of very thin scales loosely overlapping. The cones mature in one year but shed their seeds gradually, and the old cones fall off during the second summer.

The wood is extensively used as lumber, but is suitable only for rough work. It is hard to work and warps badly when exposed to the weather.

1. Western Hemlock. Tsuga heterophylla. (Rafinesque) Sargent.

The largest and best of the hemlocks, this tree grows to a height of two hundred feet, with a diameter of six or eight feet and bark an inch and a half thick. The branches are short and drooping; the leaves are two-ranked, about three quarters of an inch long, with very small teeth at the point; the cones are never more than an inch long, reddish-brown and drooping. The tree is easy to distinguish, as its short drooping branches give it the form of a very narrow cone.

Fig. 16. — Western Hemlock.

This is a valuable timber tree. Its wood is durable and free from knots. It is sawn into lumber of all kinds and ranks in value along with the spruces, pines and firs for rougher uses.

It grows in rich moist soil in river valleys and on mountain slopes, and is distributed down the coast region of British Columbia, also in suitable locations across the southern part of the province to the western slope of the Rocky Mountains.

2. Black Hemlock. Tsuga Mertensiana. (Bongard) Carrière.

This is a smaller tree than the preceding, seldom reaching a height of more than one hundred feet. It can be easily distinguished from its larger relative by the leaves, which, instead of being in two rows, are given off in all directions and are often much scattered on the main branches. The cones, too, are larger, sometimes three inches long, and erect until about half grown, but usually drooping when mature.

Fig. 17. — Black Hemlock.

The wood is light and weak and not valuable as timber, although occasionally sawn into lumber.

The tree is distributed through the mountains of British Columbia, particularly the south-central part, and ascends to an altitude of ten thousand feet on some of the mountains.

VI. The Larches

Genus Larix

The larches are tall trees, with weak, scattered, often drooping branches, which are roughened by short, scaly, rather budlike branchlets. The leaves are light green, flexible, triangular or four-sided and arranged in crowded bunches or fascicles, borne on the short lateral branchlets. Unlike the leaves of all other conifers except the bald cypress they are deciduous, turning yellow in the fall before dropping. The cones are small and erect, and fall at the end of the first year.

The larches, with their straight trunks and soft light green foliage, have never attracted the attention they deserve. Not being evergreen they are not conspicuous in the winter, while in summer they are overlooked or confused with the pines and spruces.

These are trees of the cooler parts of the northern hemisphere, three species being American and the remaining four or five either European or Asiatic. The name "larix" given to the genus is the ancient classical name given to the European larch.

1. Tamarack. Larix laricina. (Du Roi) Koch.

This is the eastern representative of the larches in America. It is a slender tree with a straight, gradually tapering trunk, seldom more than eighteen inches in diameter and covered with rough, scaly, reddish bark.

The wood is light brown, heavy, hard and strong, but not

easily worked. It is used largely for poles, railway ties and fuel, and but sparingly for other purposes.

It is distributed across Canada from Labrador to the Rocky Mountains and north to the mouth of the Mackenzie river. In the southern part of its range it is only found in cold swamps, but in the north it is found on higher ground. Usually it forms extensive forest tracts almost unmixed with other species. There are few sights of the northern forests more worthy of notice than a tamarack swamp in the fall after the leaves have turned yellow. Seen from a hilltop it spreads out like a lake of gold, and is only surpassed for beauty and mass of color by the gorgeous red and gold of the maples. Of late years, an insect, the larch saw-fly, has been introduced from Europe, which has defoliated almost all the full-grown trees throughout the greater part of its range. This insect is now being brought under control by the introduction of its natural enemies, but not before it has destroyed immense tracts of forest, and threatened the destruction of all the larch trees on the continent.

2. Western Larch. Larix occidentalis. Nuttall.

This western species is the largest and most valuable of all the larches. It is a large tree, sometimes two hundred and fifty feet high and six or eight feet in diameter. Usually, however, it is much smaller, particularly on high mountain slopes. Its leaves are pale green, slender, about one and a half inches long, and triangular. The bark is reddish, rough and scaly, and on old trees becomes very thick, sometimes near the base reaching a thickness of five or six inches. The trunk is tall, straight and naked for the greater part of its length, while at the top the branches are slender and scat-

Fig. 18. — Western Larch.

tered, and the leaves remarkably few for the size of the tree. The cones are about one and a half inches long, with thin stiff scales. The wood is dark orange, hard, durable and very heavy. It is largely used for railway ties, and to some extent in the manufacture of furniture.

This magnificent tree is found only in the valley of the Columbia River in British Columbia and southward. It occurs scattered through the mixed forest of this region, both on moist bottom lands and up the mountain slopes to an elevation of 7000 feet, but reaches its greatest development in northern Montana and Idaho. Any attempts to cultivate this tree have so far been attended with little success.

3. Alpine Larch. Larix Lyallii. Parlatore.

This tree, sometimes known as Lyall's larch, is a mountain species and much smaller than the preceding. While it sometimes grows to a considerable size, the high altitude at which it is generally found makes it more commonly a small tree or shrub.

Fig. 19. — Alpine Larch.

The leaves are very pale green, about an inch long and four-sided, while the cones are sometimes as much as two inches long.

Its range is confined to the Rocky Mountains of Alberta and southern British Columbia, and its habits are excellently stated in the following extract from a report of Mr. T. W. Dwight.

"This species is confined very closely to the area next to the timber line, although sporadic individuals may be found in mixed stands lower down. The largest tree observed was 17 inches in diameter by 90 feet in height. Usually it is of stunted growth, reaching a diameter of 7 to 8 inches and a height of 40 feet. The presence even

of a single tree is made conspicuous by its light-colored foliage. It never forms stands of any large extent and is worthy of only casual interest. The bark is very thick, approaching, in this respect, Douglas fir. On a 17-inch tree it was 1½ inches thick. When it develops to timber size it has a long, clear bole and short crown. It is rather deeply rooted. It is the most intolerant of the conifers, which makes reproduction of the scattered individuals in dense, mixed stands difficult. Reproduction of the trees near timber-line is also poor on account of the severity of the climate and the raw humus covering the soil, which is unfavorable to the germination of the small larch seeds."

Its wood has never become of commercial value.

VII. The Arbor-Vitæs

Genus Thuja

These are the trees, or at least some of the trees, which are commonly known as cedars. The true cedars, however, are an old-world genus. Their Latin name, cedrus, was first applied to the cedars of Lebanon. The origin of the word is unknown but some have associated it with the name of the brook Kedron near Jerusalem. No trees have been so often mentioned in history, poetry or prophecy as the cedars of Lebanon, and the name "cedar" spread to many kindred types, among them the arbor-vitæ.

The name "arbor-vitæ" or *tree of life* was first used by Charles de l'Ecluse, better known by his Latin name Carolus Clusius, an herbalist of the sixteenth century. About the middle of the eighteenth century the great Linnæus reduced the naming of plants to a system and gave to a very large number the names which they now bear. He gave to this genus the name "thuya" also spelled "thuja," which he adopted from Tournefort, a writer of the preceding century. The word "thuja" is supposed to be derived from a Greek word signifying sacrifice,

and may have been given from the habit of using the aromatic gum of these trees as incense in sacrifice to the gods.

Both the cedars and the arbor-vitæs were highly esteemed by the ancients, partly, perhaps, on account of their aromatic odor, but certainly because of the great durability of their wood. Pliny said that the wood of the cedar was everlasting and thought the gods were made of it.

The arbor-vitæs are evergreens, easily recognized by their yellowish-green foliage. The leaves are scalelike rather than needle-shaped, arranged in two rows on opposite sides of the flat branchlets, and overlapping in such a way that leaves and twigs seem fused. The cones are small, with loosely overlapping scales, and the wood is light, strong, free-splitting, strongly aromatic and very durable. The bark is thin and peels off easily in long fibrous shreds, varying from yellowish to brown in color.

1. White Cedar. Thuja occidentalis. Linnæus.

The American arbor-vitæ or white cedar is the only representative of this genus in Canada east of the Great Plains. It is a tree of the wet places, being usually found in swamps or along streams where it frequently crowds out almost all other species. Its characteristic yellowish-green foliage and thin bark, often hanging from the trunk in shreds, make it easy to recognize. It ranges all across Quebec and Ontario to the southeastern part of Manitoba, and is found in a small detached area about Cedar Lake, near the mouth of the Saskatchewan river.

Fig. 20. — White Cedar.

As a source of timber this tree has a special value. Its light strong wood resists decay to a remarkable degree. During pioneer days it was the favorite rail timber,

and is now used for fence posts, telegraph and telephone poles and, to some extent, for railway ties. The supply, however, limits its use. It is particularly suitable for boat-building and is largely used in the manufacture of canoes and light boats. The sapwood easily splits into thin pliable strips, out of which the Indians of the northern forests make the broad ribs for their birch-bark canoes. Boxes made of this wood are said to keep away moths. It is extensively used in ornamental planting, particularly for hedges.

2. Western Cedar. Thuja plicata. Don.

This is the big cedar of the western coast. It is one of the big trees of the continent and rivals the Douglas fir in British Columbia forests. Reaching a height of more than two hundred feet, it is sometimes as much as fifteen feet in diameter at the base. It does not carry this thickness upward for any great distance, however, much of its base diameter being made up of immense buttresses running up from the roots. Above this rapidly diminishing base it frequently has a diameter of five feet and tapers gradually to a lofty height, though sometimes it divides into several trunks. The branches are weak and small for the size of the tree, with a tendency to droop, forming a rather compact cone.

Fig. 21. — Western Cedar.

The foliage is the characteristic yellowish-green and the leaves scalelike, closely resembling its eastern relative in that respect. The bark is about half an inch thick, reddish-brown in color and broken on the surface into broad ridges.

As a timber tree the western cedar is equalled only by the Douglas fir. The wood is light and soft, but rather brittle and splits easily. It is dark reddish-brown, sometimes with pur-

plish streaks, and varied by the yellowish-white sapwood. It works easily and takes a good finish, its own rich color making a dye unnecessary. It is largely used for furniture, boxes and interior finishing for houses. The great width of the boards makes it very popular for panelling, but being soft it is easily injured. Large quantities of lumber from this tree are also used for general building purposes, while it rivals the cedar of the east in furnishing posts and poles.

This noble tree reaches its best development in moist bottom lands, but is found on mountain slopes at altitudes up to six thousand feet. At the higher levels it is much reduced in size, at times being only a shrub. It occurs in suitable locations throughout the whole coast region of British Columbia and eastward in river valleys and on mountain slopes to the western side of the Rocky Mountains.

"On the line of the Canadian Pacific Railway it first appears as a shrub on the mountains about Kicking Horse Lake, at an altitude of 6000 feet. Going westward down the valley of the Kicking Horse it soon becomes a small tree, but in the Columbia valley is rather scarce until about ten miles below Donald, where it forms large groves, and in the valleys of Beaver Creek and the Illecillewaet in the Selkirk Mountains it reaches a height of over 150 feet, with a diameter of frequently over ten feet." MACOUN.

"In British Columbia this tree abounds along the coast and lower parts of the rivers of the Coast Range, northward to Alaska, but is unknown in the dry central plateau, yet it appears abundantly on the slopes of the Selkirk and Gold Ranges." DAWSON.

This tree is cultivated in Europe, and dwarf varieties of it have also been produced and used for ornamental purposes.

VIII. The Ground Cypresses

Genus Chamæcyparis

The name "cypress," like cedar, savors of the Old World. Although the true cypresses are of another genus, the resemblance

is strong. In fact, the cedars, arbor-vitæs, cypresses and ground cypresses form a distinct group among evergreen trees, resembling each other to such an extent that the names in popular usage have become hopelessly confused. The ancients regarded the cypress as an emblem of woe. The Greeks and Romans placed its branches on the funeral pyres of their departed friends, and the Turks still plant it in their cemeteries.

The ground cypresses compose a small genus confined to the coast regions of America and Asia. They are tall, graceful trees, closely resembling the arbor-vitæs, and are generally known as some kind of cedar. In Canada there is only a single representative of these trees, and that confined to a small area of the western coast.

1. Yellow Cedar. Chamæcyparis nootkatensis. (Lambert) Spach.

This tree so closely resembles the other cedars that it is best distinguished by its general appearance. Owing to its limited range it could only be confused with the big western cedar, from which it may be readily distinguished by its size and the nature of its wood.

Fig. 22.—Yellow Cedar.

It is a tall, slender tree, sometimes reaching one hundred feet in height, with a trunk diameter of more than five feet, but usually it is much smaller. The leaves are a dull bluish-green, and dry up when about two years old, the dead leaves generally remaining on the branches for another year.

The wood is yellow, very close-grained, hard and brittle, with a satin lustre and a very strong aroma. It is durable and easy to work, and is extremely popular for interior finishing of houses and boat building.

This tree is much cultivated and is sold under a number of horticultural names.

Its distribution is confined to the coast region of British Columbia and the islands along the coast. In the northern part of its range it does not grow much above sea level, but farther south is found at higher altitudes.

IX. The Junipers

Genus Juniperus

The junipers are shrubs or small trees with either scalelike or awl-shaped leaves and strongly aromatic wood.

They may be easily distinguished from all other conifers by their fruit. This fruit is a cone in which the scales, instead of being woody or leathery, are soft and fleshy. This turns the cone into a globular fleshy fruit which is popularly known as a berry. This berrylike cone is not only the best distinguishing mark of the junipers, but gives them their greatest economic value. Several drugs used in medicine are distilled from the juniper berries, and the flavor of gin is due to the spirits being distilled along with them.

The wood is close-grained, firm, but easily worked and strongly aromatic. Under the name of red cedar the wood of some of the junipers is valuable commercially. It is used for making boxes, in cabinet work and largely in the manufacture of lead pencils. Until lately it was practically the only wood used for the latter purpose.

1. Rocky Mountain Red Cedar. Juniperus scopulorum. Sargent.

This is a short, but somewhat stout tree of the mountains of British Columbia. It seldom grows more than thirty feet high, but at times has a diameter of two or three feet.

Often the trunk divides into two or three, all rising parallel from the same base.

The leaves are small, opposite and scalelike, lying close to the branchlet. They are dark green or pale, and covered with a bloom. The fruit is bright blue, covered with a bloom, and matures at the end of the second season. Its flesh is sweet but resinous.

Fig. 23.— Rocky Mountain Red Cedar.

The wood of the Rocky Mountain red cedar is not as valuable as that of the red cedar of the east. It is red, close-grained and easily worked, and may be used for furniture or pencil-making.

The tree occurs scattered over dry mountain ridges in the southern interior of British Columbia. It grows singly or in small groups, and usually at considerable elevation. It has never been grown in cultivation to any great extent, but the success with which the northern red cedar, juniperus virginiana, has been grown would indicate that this, too, might be valuable for ornamental purposes.

THE YEW FAMILY. TAXACEÆ

This is a small family of evergreen trees or shrubs mostly found in southern latitudes, although their remains, found embedded in the rocks of Greenland, show that at one time they ranged far north. A few well-known trees grow in temperate regions, and have been so closely connected with the pursuits and habitations of man, that the name is a familar one in literature.

They are small trees or shrubs with stiff linear leaves, really arranged spirally on the stem, but so spread out as to make them appear to be in two rows. The wood is hard, durable and slightly resinous. The family closely resembles the conifers, from which it is most easily distinguished by the fruit. This is a horny nutlet, partly surrounded by a fleshy, sometimes jellylike mass, the whole enclosed at the base by several rows of overlapping scales. This fleshy fruit has the reputation of being deadly poison, but the belief seems to lack any foundation in fact.

The yews were formerly considered as belonging to the conifers, and are still sometimes so regarded in England. The latest edition of the Encyclopædia Britannica describes the European yew as "a tree which belongs to a genus of Coniferæ, in which the ordinarily woody cone is represented by a single seed surrounded by a fleshy cup." In other countries, however, these trees are now regarded as distinct from the family pinaceæ.

I. The Yews

Genus Taxus

This is the genus which has been taken as the type of the family and has all the characteristics mentioned as belonging to it. The seed is nutlike, and is not attached to the red, fleshy, cup-shaped disk in which it is embedded.

The yew trees of literature and history belong to this genus. Their dark evergreen foliage, small size, and length of life have made them at all times favorites for ornamental planting. The slowness of their growth makes them keep their shape when trimmed and adds to their value as ornamental trees or shrubs. The wood is strong, hard and very elastic, which made it very valuable in early times for bows. The famous long bow of the English archers was made from the wood of the European species, *taxus baccata*. The wood is also highly esteemed for making furniture and ornamental objects.

1. Western Yew. Taxus brevifolia. Nuttall.

This is a small but beautiful evergreen tree found growing singly or in small clumps through the conifer forests of the coast region of British Columbia. Its trunk is straight but often marked by irregular ridges, and covered by thin, dark, reddish-purple bark, which is usually much brighter in color beneath the surface. The branches are long, slender and often drooping. The fleshy cup surrounding the seed is brownish-red and almost globular.

Fig. 24.—Western Yew.

The wood is light red, hard and brittle, but very elastic. It is very durable, takes a good polish and is used for making fancy articles and paddles. When plentiful it is used even for

fence posts. The Indians formerly used it for making bows and spear handles.

Like all yews this is a good tree for ornamental planting. It is used to some extent for this purpose along the Pacific coast and has been transplanted with success to Europe, but it does not stand the climate of eastern North America.

THE WILLOW FAMILY. SALICACEÆ

While these are usually spoken of as the willow family, they include both the willows and poplars. They comprise not only trees but many of our commonest shrubs, and are present almost everywhere. All members of this family have soft wood, grow very quickly, and lose their leaves every fall. The flowers are in clusters called catkins, which in many ways resemble the cones of the pines and spruces.

The catkin consists of a short piece of stem covered with small overlapping scales. In the axil of each scale is either a clump of stamens or a small two-celled ovary raised on a very short stalk. Those catkins which have stamens have no ovaries, so they can produce no seed and are called sterile. The catkins having ovaries are called fertile because they do produce seed. When the small seed pod ripens it splits open and discharges a large number of seeds, each provided with a tuft of silky hairs on which it is carried off by the wind.

There are few trees more used by man than these. They are easily propagated by cuttings and grow rapidly, making them particularly valuable in securing quick results in park or garden planting. Where other trees are plentiful and grow easily the value of the poplars and willows is often overlooked, but on the prairie they are invaluable. They grow readily where tree growing is difficult, and wind-breaks or ornamental clumps may be provided on the open prairie in a surprisingly short time, owing to their rapid growth. They form the greater part of the natural groves and forests across the prairies, and without them the so-called treeless plains would be treeless indeed.

The wood is soft and not valuable for commercial purposes. The absence of other timber, however, has made these trees very valuable locally throughout the prairie region, both for fuel and building material.

I. The Willows

Genus Salix

Willows are either trees or shrubs and mostly of northern regions. They are readily distinguished by their narrow, almost sessile leaves and slender supple branches. The sterile and fertile catkins grow on different trees and may occur either before or along with the leaves. Usually the catkin begins to grow very early in the spring and bursts through its covering long before any other sign of growth is visible. As the scales covering the catkins are often covered on the outside with a white down, the growth has the appearance of being covered with fur. This is the well-known "pussy willow" so universally gathered by children in the early spring. These pussies are the first sign of spring and no doubt their popularity is due to that fact. The pussy willow, however, is not the willow in full bloom. It is only the enlarging bud, and it may be some time before the woolly scales covering the catkins open and allow the stamens or ovaries to come out.

The willows are proverbially fond of wet places and are found bordering all streams and ponds throughout the northern hemisphere. A few species prefer dry places and almost all will grow on well-drained soil, but the borders of streams and ditches seem to be their natural choice. If plenty of moisture is present they will grow on pure sand, but they by no means refuse to grow on rich soil as well. In fact where the water is, there they will grow, almost regardless of the kind of soil.

With us the willows are mostly shrubs, though a few grow to be large trees. Their wood is light, tough and durable, but

is only of local value for fuel or posts. In older countries the long supple branches are largely used in basketry, but that has never become an industry with us.

They are very frequently planted, but less for ornamental purposes than for wind-breaks on the prairie. Their strong vitality and rapid growth make them very valuable for that purpose. They may also be used to prevent the washing away of the banks of streams.

PEACH-LEAVED WILLOW. Salix amygdaloides. Andersson.

This is a large rough-barked tree, reaching at times a height of sixty feet, with a diameter of two feet or even more. The bark is brown or gray, thick and irregularly furrowed by deep grooves. The twigs are slender and tough, the young being orange to brown in color and with a decided tendency to droop. The leaves are bright green and finely toothed.

FIG. 25. — Peach-leaved Willow.

This tree occurs along river banks and shores of lakes in Manitoba and westward across the prairies. The wood is of little economic value, being light and rather weak, but for ornamental planting the tree has some good features. It grows quickly, has a fairly thick foliage, is long-lived and not much subject to insect pests. The small branches, however, die quickly and fall off, and it is difficult to get the trunk to grow perfectly erect. The constant dropping of dead branches and the often leaning trunk are regarded by many as objectionable features. This tree is sometimes confused with the black willow, S. nigra, which is an eastern species and not found west of Lake Huron.

WESTERN WILLOW. Salix Scouleriana. Barrett.

Scouler's willow is a tree of the western mountains. It grows to a height of sixty feet and a diameter of two feet under favorable conditions, but at high altitudes may be reduced to a shrub. It is a rather stout tree with thin, rough, dark brown bark and leaves much broader and shorter than those of the preceding species, the broad part being toward the point of the leaf.

FIG. 26. — Western Willow.

This tree is found in moist places throughout the mountain regions of British Columbia. While preferring the moist valleys, where it reaches its best development, it is also found on elevated mountain slopes, where it is usually only a shrub.

The wood is reddish-brown, soft and light, but strong and durable, and is sometimes used for handles. The tree is of considerable value for ornamental planting on the Pacific Coast.

WESTERN BLACK WILLOW. Salix lasiandra. Bentham.

This willow resembles the preceding, varying in size from a tree sixty feet high to a shrub. It differs from the western willow in having thicker bark and narrower leaves. It is a more southern tree, growing along streams through the coast and mountain States, but may be looked for in the valleys of southern British Columbia. Its use is similar to that of the preceding, with which its identity is confused.

THE POPLARS

Genus Populus

THE poplars are easily distinguished from the willows. In fact, the two genera are so different in appearance, that few people think of them as being closely related. While the willows are very often shrubs, the poplars are always trees. Under some conditions the trees may be small but they show no inclination to become shrubby. The leaves, too, are broad and supported on long slender petioles, and the branches are rather short and brittle.

The locality in which the poplars flourish is not always the border of a stream but is often a well-drained upland. They are trees of the waste places. Whenever, by fire or otherwise, land becomes denuded of its natural covering, the poplars are the first to take possession. They can be kept out only by grass, and the white birch and bird cherry are their only rivals for first possession.

While common all across Canada, the poplars are of special interest and value on the prairie. There a tree means a poplar and a bluff a grove of poplars.

The wood is light and not very durable, and has little commercial value except locally for fuel and rough lumber, and to a limited extent for paper pulp. The lack of other timber, however, has made it very valuable on the prairie. The fuel and building material of the pioneer over the greater part of the Canadian plains were furnished by the poplar woods.

AMERICAN ASPEN. Populus tremuloides. Michaux.

This is the most widely distributed and best known of all the poplars. It is a slender tree with short, weak, irregularly

spaced branches, and thin, smooth, yellowish-green or whitish bark, the outer surface of which rubs off as a white dust. At the base of old trees the bark may become thick, rough and almost black. The leaves are orbicular, finely toothed, a light green when young, but becoming darker with age. The petioles are long, slender and flattened, so that the leaf trembles very easily in the slightest breeze. This is why it has a reputation for having leaves that are never at rest. The trembling leaf of the aspen has been mentioned frequently in poetry, and given rise to many myths and superstitions. Scott refers to it when describing the march of the Earl of Marr's army just before the battle at the mouth of the Trossachs.

Fig. 27. — Aspen.

> "There breathed no wind their crests to shake,
> Nor wave their flags abroad;
> Scarce the frail aspen seem'd to quake,
> That shadow'd o'er their road."

The French Canadian lumbermen have a superstition that poplar was the wood out of which the cross was made upon which Christ was crucified. For that reason the tree was condemned never to be at rest and the leaves could always be seen to tremble. The wood was regarded as bringing bad luck, and many men would refuse to trust their lives to a crib if any poplar had been used in its construction. The poplar of this superstition was, of course, the aspen.

Of the different races of trees which succeed each other in the changing life of a forest, the aspen is among the first. Owing to its method of spreading seeds and its rapid growth, it gets possession of all waste places before any other tree. It forms

the ground cover under which the conifers are able to develop, until they crowd out the quick-growing and short-lived poplars, — the conifers themselves to be replaced in time by the more enduring hardwoods.

The aspen is the "white poplar" of the prairie. Its clean slender trunks furnished the pioneer with logs for his building, posts for his barbed wire fences and fuel through the long winter. It is the only tree that seems to have vitality enough to successfully compete with grass for the possession of the soil. An aspen grove will spread outward over the open prairie if protected from fire. In fact, the prairie fire was apparently the only factor which prevented this persevering tree from getting full possession of the prairie, and if man had not appeared upon the scene, it might yet have covered these great plains with its graceful silvery stems and tender foliage.

This tree prefers light dry soil, and will not stand cultivation well. It is very susceptible to fungous diseases and seldom escapes for long, if the grove in which it lives has been cleared out for park or pasture. Unlike the other poplars, it is propagated almost entirely by seed. It seldom sends up shoots from the roots, and I have never been able to grow it from cuttings. It grows very readily, however, from seed, and while young grows so rapidly that it can compete successfully with any other form of vegetation. It does not transplant well, is little used as an ornamental tree and its wood is of purely local value.

It is distributed all across Canada and northward as far as timber grows. In some places it forms dense forests, in others scattered groves, but more generally is found in mixed forests or in pure stands on lands which have been burned over.

Balsam Poplar. Populus balsamifera. Linnæus.

This is the tree called "black poplar" by the pioneer on the prairie. It is also known as Balm of Gilead, although, properly

speaking, that term belongs to a more eastern species. The balsam poplar is easily distinguished from the aspen by its large, resinous and strong-smelling buds, and its more pointed leaves, which vary from a bright shiny green when young to a rusty green when mature. The bark is smooth and greenish on young trees, but becomes thick, rough and gray as the tree gets older. The tree, too, is larger than the aspen and grows along streams and in moist places.

Fig. 28. — Balsam Poplar.

The balsam poplar is a very quick-growing tree; it transplants easily and is readily grown from cuttings. Where quick results are required it is valuable for planting, but it sends up a great many shoots from the roots. This makes it undesirable, especially beside grass plots. The wood is dark and of little value even for fuel.

Black Cottonwood. Populus trichocarpa. Torrey and Gray.

This is the Rocky Mountain and Pacific coast representative of the preceding species. It closely resembles the balsam poplar of the prairies but is a larger tree; in fact, it is the tallest of all the poplars, sometimes reaching a height of about two hundred feet.

The bark is thick, gray and very rough on old trunks, and the buds are large, resinous, bright brown and often slightly curved. The leaves are broad at the base, narrowing to a sharp point, bright green, smooth and shining above, and whitish beneath.

The wood is brown in color, light and weak, but is often used for bowls and such

Fig. 29. — Black Cottonwood.

things, where a soft wood that is not liable to split or sliver is desired.

It occurs in the valleys and on the lower slopes of the mountains of southern and central British Columbia and northward along the Pacific Coast to Alaska. On the eastern side of its range it becomes fused with the preceding and the two following species.

NARROW-LEAVED COTTONWOOD. Populus angustifolia. James.

The narrow-leaved poplar closely resembles the balsam poplar, but is distinguished by its long narrow leaves and almost upright branches. Its range does not seem well defined, as it is not sharply distinguished from the balsam poplar in the north. By some it is regarded as merely a variety of the balsam poplar, while others assert that it hybridizes freely with it.

It is found quite distinct and easily distinguishable from the other in the southwestern part of the prairie region, but its identity becomes fused with that of other species to the north and east. It has been mentioned by some writers as occurring as far east as southern Manitoba and the Red River valley, but I have never seen it there.

COTTONWOOD. Populus deltoides. Marshall.

This is the necklace poplar of the Eastern States, and although not the tallest, is one of the stoutest of them all. The trunk often has a diameter of more than six feet, while it seldom reaches one hundred feet in height. The bark on old trunks is very thick and rough, but on young trees is smooth. The buds are not so large as those of the balsam poplar and are only slightly resinous. The tree is easily distinguished by its very large leaves, often more than four inches across. These are somewhat triangular in shape, the base of many of them being almost a straight line. The petioles are long, flat and red when young. The fertile catkins when ripe have the appearance

of a necklace, and falling to the ground about the tree, are very noticeable.

The cottonwood is found in moist sandy locations along lake shores and the banks of streams across the prairie, fusing in the western part of its range with the next species, which differs from it so slightly that it is often regarded as merely a variety. These two species were formerly included in one under the name populus monilifera, Aiton.

Fig. 30. — Cottonwood.

The wood has not proved valuable as a timber, although used locally for fuel and building logs. It has been freely used for planting and is very satisfactory, except that it is more liable to insect pests than any other poplar. When the native tree is planted the leaves turn yellow and fall early, but the eastern form, which is often sold under the name Carolina poplar, retains its leaves until the frost comes. The latter, however, is not altogether hardy on the prairie, as the new growth usually kills back.

It grows readily from cuttings, and its rapid growth makes it a desirable tree with which to secure quick results either for street or park planting. It is too large for planting in small grounds.

Fig. 31. — Long-leaved Cottonwood.

Western Cottonwood. Populus Sargentii. Dode.

The distinction between this and the last species is not very marked. It is the western cottonwood and formerly was not regarded as distinct from the preceding. On the whole it is taller and has a greater

spread of branches. This may be the tree referred to by Macoun under the name of populus monilifera when he says: "At Big Stick Lake, north of the Cypress Hills, there was a grove of these trees of a very large size in existence in 1880. These had escaped the annual prairie fires, being surrounded and partly covered up by sand, and stood as a proof of the existence of forests in the past, where now there is not even a bush. The trees were over fifty feet high, and some of them at least two feet in diameter."

Britton gives its range from Saskatchewan and Alberta to South Dakota, Nebraska, Kansas and Colorado.

This is the cottonwood of the Western States, and it has been largely used there for planting. The ranges of this and the preceding species seem to meet in Alberta and Saskatchewan, and their identity is not clear where they mingle. Usually the term "cottonwood," without any qualifying word, means either of these two trees.

SILVER-LEAVED POPLAR. Populus alba. Linnæus.

The white poplar of Europe has been sparingly introduced and is quite hardy throughout our range. It is easily recognized by its slightly three or five-lobed leaves, which are rather sinuately toothed and dark shining green above. The young stems, the petioles and the under sides of the leaves are all densely white-woolly.

It grows rapidly, produces a good foliage and is easily propagated from cuttings, but has the disadvantage of sending up numerous shoots from the roots.

RUSSIAN POPLAR

Under this name a number of Asiatic species have been introduced for ornamental planting. There are at least three species, *populus petrovski*, *populus certinensis* and *populus wobstiriga*,

and their identity is confused. The trees differ in habits of growth, as well as in the shape of the leaves and the character of the buds.

These Russian poplars have proved exceedingly valuable on the prairie. They are easily reproduced from cuttings, grow very rapidly, keep their leaves until the frost comes and yet are perfectly hardy. They are not liable to insect pests to any great extent, but they have the fault, common to all poplars except the aspen, of sending up numerous shoots from the roots.

THE BIRCH FAMILY. BETULACEÆ

This family includes, not only the birches, but the alders and hazelnuts. Many of its members are shrubs, but others are large, usually very graceful trees.

The leaves are simple, alternate and variously toothed, but seldom lobed. The flowers are small, arranged in dense catkins, the sterile and fertile both growing on the same tree. The sterile catkins are usually slender and drooping, the fertile erect and somewhat rigid, often remaining on the tree long after the seed has been discharged.

I. The Birches

Genus Betula

This is the type of the family and has all the family characteristics plainly marked. Its members are mostly but not always trees. Several northern species are shrubs. The trees are tall and graceful with slender branches, the branchlets often drooping.

The bark, while thick and rough on the old trunks of some species, is usually comparatively thin, the outer part being made up of paperlike layers.

The wood is close-grained, hard and splits freely. Owing to the resemblance in the grain it is often used as a substitute for mahogany in furniture making. Both bark and wood contain an oil which makes them burn readily.

1. White Birch. Betula alba, Linnæus, var. papyrifera.

This is the canoe or paper birch of the northern woods and is the most widely spread of all in its range.

It is a graceful tree, sometimes of considerable size, and easily distinguished by the bark. This is usually smooth, and on young stems is reddish-brown, but as the stem gets older it becomes a bright white on the outside, remaining yellow or orange beneath the surface. The outer bark peels off in thin layers, making the birch bark which is put to such a variety of uses. The Indian's birch-bark canoe is known to the world, but it has many other uses not so well known.

Fig. 32.—White Birch.

The wood is hard and strong and is much used for spools, handles of tools and furniture. It is also highly valued as fuel, the oil which it contains making it burn freely even when green.

The canoe birch is found across Canada from the Atlantic Ocean to the Pacific and northward to the mouth of the Mackenzie river. It shares with the poplar and bird cherry the distinction of being the first tree to take possession of land over which fire has recently run, and only the black and white spruce and tamarack grow as far north. It varies greatly in different parts of its wide range, the various forms being frequently known by distinct names, for example: "The British Columbia form has much shorter and thicker leaves and a very different bark, so that it may be a distinct variety, and in that case should appear under Lyall's name." Macoun.

As a cultivated tree it is graceful, and is sometimes spoken of as the most ladylike of all our trees. It prefers light soil and grows rapidly at first, but does not seem to live long.

We often see the shining white stems of young birches in parks and gardens, but no one sees or hears of a gnarled old birch. The beeches, the elms and the oaks grow old in cultivation, but the birches, like the good, die young.

FIG. 33. — Mountain Birch.

2. MOUNTAIN BIRCH. Betula fontinalis. Sargent.

This is either a shrub or a small tree, seldom more than thirty feet high. The bark of the stem is thin, a dark bronze in color, smooth and shining, while the twigs are grayish and rough. The leaves are almost orbicular and supported on short petioles.

This small birch is found in the Rocky Mountains and spreads eastward in the river valleys. It is much confused with the next species in the mountain district.

3. WESTERN BIRCH. Betula occidentalis. Hooker.

The western birch is a large tree, often more than one hundred feet high and three feet in diameter. It reaches its best development in the State of Washington, varying from a medium-sized tree to a shrub in British Columbia.

Its outer bark is yellowish or brown, smooth and shining, and easily peels off. The inner bark is much lighter in color. The leaves are broad at the base, tapering to a rather sharp point, coarsely and sharply toothed, and frequently doubly toothed.

It occurs throughout British Columbia and eastward, where it mixes and becomes confused with the preceding species. Macoun is evidently mixing the two species when he gives its range as "Rather common in British Columbia, extending eastward to the Saskatchewan plains."

II. The Alders

The alders resemble the birches sufficiently to have been formerly included in the same genus. The bark does not peel off in layers like that of most of the birches, and the oil in the bark and wood is absent in the alders. The fruiting catkins are almost globular and remain on the stem sometimes for a year after the seed has been discharged. The wood is very soft and weak, the juice watery and the bark astringent.

1. Red Alder. Alnus oregona. Nuttall.

This is a tall tree with a weak, often leaning trunk, but frequently of considerable size. It reaches a height of about seventy-five feet and a diameter of two feet.

Fig. 34.—Red Alder.

The bark is almost smooth and light gray or whitish in places. The leaves are large, often six inches or more in length, rather sharp-pointed, coarsely toothed and very prominently veined.

The wood is light reddish-brown and takes a very good polish, but is soft and weak. It is used, however, for furniture and even for canoes by the Indians. The ease with which it can be worked causes it to be used for many purposes where a stronger and more durable wood might be thought preferable.

It occurs along the Pacific coast throughout the whole length of British Columbia, often forming the first fringe at the water's edge.

THE BEECH FAMILY. FAGACEÆ

This family includes the oaks, beeches and chestnuts, which are among the best known and most useful hardwood trees. They are widely distributed, being found all over the earth, and rank next to the pines in economic value.

The members of this family have simple, deciduous, pinnately veined leaves, sometimes variously lobed; but their most distinctive feature is the fruit. It consists of a nut with a tough or hard shell surrounded by, or embedded in, a fleshy spiny outer covering. This outer coat is made up of the thickened bracts of an involucre which surrounds the fertile flower. The acorns, beech-nuts and chestnuts are so well known, that they need only to be mentioned to bring up associations with the noble group of trees which bear them.

Like most hardwood trees, the oaks, beeches and chestnuts thrive best in a moist and temperate climate. One species of oak is the only member which has proved itself able to stand the drought and cold of the prairies. There seems little reason to doubt that, given time, these trees would have reached the coast region of British Columbia. That province is still in the conifer stage of its forest development. The march of the hardwood forest has not reached it, and now that man has interfered, it never will reach it in the natural way. A single species of oak is found on Vancouver Island

I. The Oaks

Genus Quercus

"The Monarch oak, the patriarch of trees,
Shoots rising up, and spreads by slow degrees:
Three centuries he grows, and three he stays
Supreme in state; and in three more decays." Dryden.

The oaks are the most celebrated and valuable of a well-known and important family. They are trees of the northern hemisphere, and with a few exceptions are confined to North America.

While America may have the greater number of species, still the tree which made the oaks famous belongs to Europe. This is the celebrated British oak (Q. robur). It is the oak of history, poetry and myth. It constituted a considerable part of the original forest, not only of Great Britain, but of all Europe south of the Baltic Sea. For ages it has been regarded as the type of rugged endurance, and thus a type of things British. It was of it Ruskin was thinking when he wrote:

"The ideal of the mountain oak may be anything, twisting and leaning, and shattered, and rock-encumbered, so only that, amidst all its misfortunes, it maintain the dignity of oak; and indeed, I look upon this kind of tree as more ideal than the other, in so far as, by its efforts and struggles, more of its nature, enduring power, patience in waiting for and ingenuity in obtaining what it wants, is brought out, and so more of the essence of oak exhibited than under more fortunate conditions."

"There is in trees no perfect form which can be fixed upon or reasoned out as ideal; but that is always an ideal oak which, however poverty-stricken, or hunger-pinched, or tempest-tortured, is yet seen to have done, under its appointed circumstances, all that could be expected of oak."

The wood of the oak has always been used wherever hardness and endurance were desirable, but the diminishing supply is now restricting it largely to inside finishing and furniture. No wood resists water so well, and, when kept dry, it is practically indestructible. The bark is a valuable source of tannin, and cork is the outer bark of a species of oak.

They are essentially trees of the northern hemisphere, and although Europe and northern Africa have furnished the earliest and most widely known species, by far the greater number

belong to America. They reach their best development in the southern part of North America, ranging south along the plateau to about the equator or a little south of it. Only two species are found in the four western provinces of Canada.

"He who plants an oak, looks forward to future ages, and plants for posterity." WASHINGTON IRVING.

1. BUR OAK. Quercus macrocarpa. Michaux.

In the more southern and eastern part of its range the bur oak grows to be one of the largest of oak trees. It sometimes reaches a height of more than one hundred and fifty feet, with a diameter of six or seven feet. It is found in thickets or open groves throughout Manitoba as far north as the Riding Mountains, and extends west for a short distance into Saskatchewan, especially along the valley of the Qu'Appelle. This, however, is the extreme northern and western limit of its range and it is much reduced in size, being a small, rather stunted tree, seldom reaching a diameter of more than twelve inches.

FIG. 35.—Bur Oak.

It is easily distinguished by its characteristic sinuately lobed leaves and its acorn with a very deep cup.

Its use is entirely local, mostly for fuel or fence posts. Its growth is very slow and, consequently, it has not yet found favor as a cultivated tree; but it can be transplanted when young by taking reasonable care, and its long life may yet make it more used for decorative purposes.

FIG. 36.—Garry Oak.

2. Garry Oak. Quercus Garryana. Douglas.

This is the principal oak tree of the Pacific slope. It sometimes reaches a height of more than one hundred feet, but its best development is south of the Canadian boundary.

The leaves are large, thick and leathery, deep green and rather irregularly lobed, the terminal often three-lobed. The bark is dark brown or gray, about an inch thick and broken on the surface into low ridges. The fruit is an acorn with a very shallow cup.

The wood of this oak is valuable for furniture, house finishing and any work where durable wood that takes a good finish is required.

Its only occurrence in Canada is in the southern part of Vancouver Island, and the islands of the Gulf of Georgia.

THE NETTLE FAMILY. URTICACEÆ

It is a long call from the stinging nettle to the elm tree, and yet on account of resemblances which are not apparent to every one, they belong to the same family and it is the nettle, not the elm, that gives the name. It is a large family of mostly tropical plants, and a detailed account of their characteristics is not necessary that we may appreciate the beauties of the elm tree.

I. The Elms

These are all trees with simple alternate leaves, always prominently pinnately veined and usually oblique at the base. The fruit is a flat nutlet, winged all around, and falls early in the season. The genus contains a small number of trees, all highly valued for their beauty of form and the strength of their wood.

1. The White Elm. Ulmus americana. Linnæus.

The white or American elm is one of the biggest, most widely distributed and best-known trees on the continent. It grows at times to a height of more than one hundred feet, with massive trunk and branches. Strong buttresses often run up the trunk from the large roots.

The tree is easily distinguished by its rough, gray bark, long, supple, and sometimes drooping branches, and simple, pinnately veined leaves arranged in two ranks. The leaves are coarsely toothed or double-toothed and quite oblique at the base. The fruit, a nutlet surrounded by a wing, ripens and falls in June.

No tree in America has been more popular for street and park planting. Its large size, graceful spreading top and long life

combine to make it an ideal tree for parks and streets. Within its range in Manitoba it is rapidly becoming the most commonly planted tree, particularly in the southeastern part of the province. It would be little less than a tragedy if the popularity of this noble tree should bring about its destruction. The exclusive planting of a single species tends to so increase the food supply of its enemies that they increase at an even greater rate. This will only be checked by the destruction of the food, which means the destruction of the tree so largely planted. There is a danger of this fate overtaking the white elm. The elm beetle has so increased in some places in the Eastern States that the elms seem doomed.

Fig. 37. — White Elm.

The elms of Manitoba have not suffered seriously from insect pests thus far, but what has happened in other places will happen in the prairie province, if too exclusive planting of a single species is followed.

The rich moist land of the river bottom is the favorite place of the elm. Still it will grow well on higher and well-drained land, but lack of moisture must be balanced by greater richness of soil.

The wood of the elm is very largely used for cheap grades of furniture and for barrels, but is not considered desirable for high-grade articles.

It is found in low land throughout Manitoba as far north as the mouth of the Saskatchewan river and westward into the province of Saskatchewan.

It can be grown readily from seed, but the seeds should be gathered in the summer and sown at once. If kept over, they lose their vitality very quickly. It is not advisable to attempt to grow trees in the northern part of the range from seed col-

lected much farther south. Often they are not hardy and this is particularly the case with the white elm.

II. The Hackberries

Genus Celtis

The hackberries may be distinguished from the elms by having larger, rather hairy leaves, and fruit in the form of a drupe, sometimes edible. The bark, on old trees, becomes much thickened in warts or ridges which are very conspicuous and form a distinguishing mark.

The Hackberry. Celtis occidentalis. Linnæus.

This is a rather small tree in our climate and is very local in its distribution. It has large, light green, thin leaves, with a somewhat woolly appearance. The drupes occur singly in the axils of the leaves and vary in color from red to black. The trunk has often a stunted appearance and is strongly marked by thickened corky ridges of bark.

"Without exception this tree has the most remarkable distribution of any in the Dominion. A few grown trees here and there are all that are usually found in the same locality."

Macoun.

Fig. 38.—Hackberry.

True to its reputation for peculiar distribution, the hackberry is found mixed with ash and maple on the sand bars near Delta at the south end of Lake Manitoba. There are no really young specimens, but it seems to send up shoots quite readily from the roots. The trees are quite hardy, as they stand exposed to the north wind off the lake, and although somewhat stunted, are healthy.

They suffer more from breaking by snow and barking by rabbits than from wind or frost. As far as is known this seems to be the only occurrence in any of the four western provinces. There is no reason why this should not be a valuable tree for ornamental purposes. It is quite hardy, long-lived, possesses good foliage and does not seem subject to insect pests. Reproduction would have to be from the root, as the seeds do not germinate, and this would prevent raising any larger number of the trees. It may be that the reason no seedlings are found is that the seeds are eaten by birds as soon as they ripen.

THE ROSE FAMILY. ROSACEÆ

This is one of the largest and best known of all the plant families. It includes many of our flowers and fruits, but in our climate produces no really large trees. A large number of small trees and shrubs belong to it, and at least some of these should be mentioned.

Plants of this family are easily distinguished by their alternate, often compound and always stipulate leaves and showy flowers. The sepals and petals are mostly in whorls of five; the stamens are numerous and inserted on a fleshy ring on the calyx at the base of the petals.

The rose, the best known of all flowers, has given the name to this family and that alone would make it famous; but it is not less famous for its fruits. The apple, cherry, plum, peach and pear are but types of fruit-bearing trees, while the strawberry, though humble in habit, has added to the reputation of this family by its distinctive flavor.

I. The Cherries

Genus Prunus

Trees of this genus produce what are known as the stone fruits. The fruits are drupes, — hard-shelled nuts or stones enclosed in fleshy coverings. The cherries, plums and peaches belong here, and the prunes have shared their name with the genus.

1. Bird or Pin Cherry. Prunus pennsylvanica. Linnæus fils.

Among the best known and most widely distributed of our trees is the common red cherry. It is small with smooth,

reddish-brown bark which easily peels off in layers and long, graceful, often drooping branches. When young the twigs are bright red. The fruit is red, pleasantly acid and of some local value. This tree is found all across Canada from the Atlantic to the Rocky Mountains. It grows scattered through the open woods where it attracts little attention, but when any land has been newly burned it joins with the poplars and birches in taking first possession. It is particularly well suited as a re-foresting agent, as its shortness of life prevents it being a serious competitor with more permanent species. This, perhaps, is its chief use, but its light green foliage, graceful drooping branches, snow-white flowers and cheering fruit would be missed by all who take pleasure in things out of doors. The birds, too, would miss it, and we would miss the birds. Altogether this little tree has not established a reputation for high economic value, yet it has won a place in our lives and interest that we would not like to see vacant.

Fig. 39. — Bird Cherry.

Fig. 40. — Western Bird Cherry.

For ornamental purposes it has never received the consideration it deserves, although its value is more as a shrub than a tree. For covering waste places or thickening shrubberies it has much to recommend it, not the least of which is the profusion of beautiful white blossoms which appear along with the leaves in the spring. It transplants easily, although, as in most members of this family, the rootlets readily drop away when the plant is disturbed, making the root look very naked.

In spite of this, however, if given any reasonable care, the cherry will soon establish itself in a new location. Its chief fault is that it sends up numerous shoots from the roots, especially if the ground about it is kept cultivated; but sometimes this is more a virtue than a vice.

2. Western Bird Cherry. Prunus emarginata. Walpers.

This is the western form of the preceding and is not always separated from it. It is found in the coast region of southern British Columbia, and has broader leaves and more upright branches than the common bird cherry. The flowers are greenish-white, arranged in a short raceme-like cluster.

II. The Apples

Genus Pyrus

This division of this large family includes those having a fruit known as a pome, which is generally a large fleshy fruit of rather firm texture, with the seeds at the centre, enclosed in a number of distinct cells. The apple and pear are the well-known types, and the genus takes its name from the Latin word for pear. Sometimes, however, these fruits are small and may easily be confused with berries or drupes. The structure of the fruit is the same, the difference being mostly in size.

1. Oregon Crab. Pyrus diversifolia. Bongard.

Fig. 41. — Oregon Crab.

This is the only apple tree that is a native of Canada, and it is found only along the coast region of British Columbia. It reaches its

greatest size in Oregon, where it may be more than thirty feet high. Usually it is not more than a shrub in Canada.

The fruit is a little apple, about half an inch or less in diameter, but differs from most apples by not being depressed at the base. It is red or yellow, sour to the taste and edible, although the fleshy part is small compared with the size of the seeds.

The wood is firm and hard and is sometimes used for mallets or handles.

2. Mountain Ash. Pyrus americana. (Marshall) De Candolle.

If any tree has ever masqueraded under a false name, surely it is the mountain ash. To begin with it is scarcely ever a tree, being usually a shrub not more than twenty feet high, yet it is always called a tree. It is not an ash and it does not live on the mountains. On the contrary, it belongs with the pears and apples to the rose family, and it grows in wet places. The Scotchman or Irishman thinks he settles the matter when he calls it the "rowan tree," but the botanist assures us that this name belongs entirely to a European species, and so our tree is left without any name to which it really has a right. Even when it is put where it belongs, among the apples and pears, it looks out of place, for it has no outward resemblance to these. Yet it is one of our oldest and most esteemed friends, and we would not accuse it of deception.

Fig. 42. — Mountain Ash.

This small tree or shrub is found growing in moist places or cool rocky woods across Canada, from the Atlantic Ocean to the eastern shore and islands of Lake Winnipeg. Its most distinctive features are its smooth, or but slightly roughened, thin, grayish bark, which when scraped off or bruised gives off a

pleasant, rather aromatic odor; its large, rather drooping compound leaves with from eleven to seventeen leaflets; and its broad flat clusters of greenish-white flowers, followed by equally broad and very showy clusters of bright red fruit. Each fruit is in reality a small, slightly pear-shaped pome, about a quarter of an inch in diameter, but the cluster resembles a bunch of berries and the fruit is generally spoken of as "mountain ash berries." It remains on the tree the greater part of the winter and is a favorite food for birds, particularly for grosbeaks and other winter birds of the northern woods.

The graceful appearance of this little tree, as well as the beauty of its foliage and fruit, has made it a favorite for ornamental planting throughout its range. No other tree or shrub of its size has been so generally removed from its woodland haunts to grace the door-yard of the pioneer; and its popularity has survived the pioneer days, the bronze-green leaves and scarlet fruit being now familiar objects on city lawns. Its wood has no economic value, but as long as beauty of form and color are prized by man, this tree will find favor because of the touch of refinement it adds to a woodland scene otherwise somewhat severe.

THE MAPLE FAMILY. ACERACEÆ

THE maple family is not large, but many of its members are distinguished. They are almost all trees, with a watery juice rich in sugar, and broad, simple, palmately lobed leaves. There are some exceptions to this rule, as a few are shrubs and one division of the family has compound leaves. The family comprises but a single genus, the well-known maples.

I. THE MAPLES

Genus Acer

"All hail to the broad-leaved maple
In her fair and changeful dress,
A type of our youthful country
In its pride and loveliness.
Whether in spring or summer,
Or in the dreary fall,
'Mid nature's forest children,
She's fairest of them all."

No trees are so closely connected with Canadian traditions and history as the maples. If we can be said to have a national tree, it is the maple, and the maple leaf has come to be considered the emblem of Canada. There are a number of maples, all noble trees with broad, palmately lobed leaves, and just which one should be considered as furnishing the maple leaf of Canada is a matter of some confusion. There seems little doubt, however, that the tree which so impressed the early settlers that it became closely associated with the growing

colony, was the hard or sugar maple. It was the most prevalent on the eastern side of the continent, where it formed extensive forests. Its wood soon became regarded as the most valuable fuel, and from its sap was made the maple sugar of the pioneer days. In the fall its leaves became brilliant crimson or gold, giving color on a scale never furnished by any other tree. No tree touched the lives of the people at so many points, or was so likely to be regarded by the immigrant as standing for the land of his adoption.

The leaf of the silver maple is more deeply lobed, and altogether more beautiful in outline than that of the sugar maple, and very often the leaf used as the Canadian emblem resembles it more nearly than any other. This, however, does not make the silver maple the Canadian national tree.

The range of the maples is confined almost entirely to the eastern forest region of the continent, a few species only ranging farther west.

The trees which have been the chief source of maple sugar are the sugar maple, *acer saccharum*, and the black maple, *acer nigrum*. These are closely related and occur mixed over the same range. They are also the hard maples, the wood being hard and durable and much used for flooring, furniture, decorative work and tool handles. Trees with a peculiarly twisted grain furnish the highly prized "bird's-eye maple."

The term "soft maple" is variously used to designate the wood of several other members of the family but is most frequently applied to the red maple, *acer rubrum*, and the silver maple, *acer saccharinum*.

1. Manitoba Maple. Acer Negundo. Linnæus.

This belongs to the group known as the ash-leaved maples, and is often called box elder. It is a rather small tree, although it sometimes reaches a height of sixty feet and a diameter of about three feet.

The bark on old trees is grayish-brown, thick, rough and scaly. On young trees it is light gray, thin and smooth. The leaves are pinnately compound of three or five leaflets, the end leaflet on a long petiole and the lateral ones short-stalked. The leaflets may be either entire, or more or less three-lobed.

The staminate and pistillate flowers are on different trees and open before the leaves. The staminate flowers are on long, drooping, hairy pedicels, while the pistillate ones are in racemes which lengthen as the fruit matures. The fruit is a double samara.

FIG. 43. — Manitoba Maple.

The wood is light, soft and of little value except locally as fuel. The tree has been much used throughout the prairie for planting, for which it is in some ways well suited. It grows rapidly and its leaves come early, so that it furnishes green foliage earlier than any other native tree in its range. It is short-lived, much given to forking, splits easily at the forks, and is very liable to be attacked by insects, particularly the green aphis. When a bad attack of aphis occurs, a sticky secretion from the insect, known as "honey dew," smears the leaves and runs down the trunk or falls in drops to the ground. This often causes a fungous growth on the bark, making it black and unsightly. The leaves fall early, especially if infested with aphis, and thus what it gains in foliage in the spring it loses in the fall.

In spite of its defects, there is no reason why this should not continue to be valuable for street or park planting, if mixed with other species. Exclusive planting of this species, however, tends to breed its enemies and should be avoided.

The Manitoba maple occurs native along the valleys of streams across the prairie past the western boundary of Saskatch-

ewan, and as far north as the Saskatchewan river; but it has been successfully grown still farther west. It is easily grown from seed, and its sap may be used for making sugar.

2. Mountain Maple. Acer spicatum. Lamarck.

This is usually a shrub, but may sometimes grow to the size of a small tree. The bark is thin and brownish, the young twigs being red in winter. The leaves are thin, slightly three-lobed, and reddish when young. The fruit is a double samara arranged in drooping racemes. This tree occurs in low places along the eastern side of Manitoba, and westward across the province at about the latitude of the larger lakes, and extends for some distance into Saskatchewan. It generally grows as a shrub or a clump of small trunks from a common root. It is too small to be of any economic value, as the wood is light and soft, but it is sometimes planted as a shrub. When this is done it should not be in an exposed position, as it will not stand a scorching sun.

Fig. 44. — Mountain Maple.

3. Silver Maple. Acer saccharinum. Linnæus.

This beautiful tree has been successfully introduced into Manitoba and thrives well on the rich soil of the Red River valley, where its growth is very rapid. Some fine specimens, almost two feet in diameter, may be seen in the city of Portage la Prairie, and equally good success has attended its cultivation farther south. At Brandon, where the altitude is higher, its growth is much slower, and its final success is still a matter of doubt.

It is a graceful tree with long branches and beautifully lobed leaves, bright green above and silver-white beneath. The bark is thick and rough on the old trees, but on young stems is thin, smooth and a beautiful silvery-gray.

It is a tree well worth cultivating where its growth is assured, but it does not seem to mature its seeds in Manitoba. I have tried in vain to germinate them, and have never been able to find any young trees growing where the seed falls.

FIG. 45. — Silver Maple.

FIG. 46. — Broad-leaved Maple.

4. BROAD-LEAVED MAPLE. Acer macrophyllum. Pursh.

The broad-leaved maple is so called on account of the size of its leaves, which are six or eight inches across when full grown. The leaves are deeply three or five-lobed, on long petioles, and heart-shaped at the base. They are dark green, shiny above and lighter beneath, and coarsely toothed or wavy on the margin. When young they are densely hairy, but almost naked when mature.

The bark is grayish-brown, rather thick and scaly on old trunks, but thin and smooth on the branches. The twigs are red in winter but afterwards turn gray.

This is a forest tree of the Pacific coast. It grows at most to a height of about ninety feet, with a diameter of about three feet, and the branches are long and sometimes drooping at the ends. It is found along the Pacific coast as far north as Alaska and extends inland in the valleys at the southern part of the province, but reaches its greatest size farther south.

Fig. 47. — Vine Maple.

5. Vine Maple. Acer circinatum. Pursh.

This is a trailing or somewhat climbing tree which grows along streams in the southern part of British Columbia near the coast. Sometimes it forms dense thickets. It has smooth, reddish-brown bark and almost orbicular, five or seven-lobed leaves on short petioles. The sterile and fertile flowers grow together in drooping clusters at the ends of the branches, and open almost with the leaves.

The wood is light brown, hard and durable, and is used to a small extent for making tools and other small articles. It has been used considerably in cultivation and may be trained to be very ornamental.

THE BASSWOOD FAMILY. TILIACEÆ

The basswoods or lindens are a large family but are not represented on the western side of North America. A single species reaches the interior of the continent and is found in southeastern Manitoba.

On this continent members of this family are always trees; they have large, simple, alternate leaves and regular perfect flowers, mostly in sets of five parts The fruit in our species resembles a nut, but in reality is a drupe in which the outer covering is not fleshy.

The family is noted for possessing tough fibrous bark. Jute fibre is made from one of its members.

I. The Basswoods

Genus Tilia

The basswoods are all trees and usually large. They have large, simple, alternate leaves with stipules which fall away very early. The flower consists of five petals, five sepals and numerous stamens, all inserted on the receptacle. The petals have a petal-like scale at the base of each and the stamens are collected in groups, one at the base of each scale.

The bark is rough, thick and corky on the outside, but tough and fibrous within. This fibrous bark has been used for many purposes both in the older countries and among the pioneers of America.

This genus is confined entirely to the temperate parts of America, and mostly to the eastern part.

1. Basswood. Tilia americana. Linnæus.

The basswood is usually a lofty tree of large size, but does not reach its best development west of the Great Lakes. In Manitoba it often grows in clumps, several small trunks from the same root.

The bark is gray, about half an inch thick on old trees, and much roughened on the outside. As in all other members of the family the inner bark is tough and fibrous. The leaves are from four to six inches long, orbicular, sharply toothed and tapering to a sharp point. The flowers are large, yellowish-white and arranged in drooping racemes. The peduncle of each raceme springs from the base of a long bract which runs along it for some distance. The fruit is a nutlike drupe.

Fig. 48. — Basswood.

The wood is light, soft and easily worked, but not durable if exposed to moisture. It is very popular for making shelves and backs for furniture, table tops, carriage boxes, canoes, and indeed for any purpose where light, easily worked wood can be used. Wooden utensils and paper pulp are also made from the basswood.

Besides being a popular timber tree, it is one of the best native trees for ornamental purposes. Its large, fragrant flowers, and dense foliage not liable to insect attacks, make it a beautiful lawn or street tree.

It grows along the river bottoms in southeastern Manitoba, and is confined almost entirely to the Red River valley. It is not native at Brandon, but when planted does fairly well.

THE DOGWOOD FAMILY. CORNACEÆ

This is a small family, mostly shrubs or trees, and represented with us by a very few species of a single genus.

I. The Dogwoods

Genus Cornus

The dogwoods are flowering trees or shrubs, varying in size from a small tree to the dwarf bunch-berry, which is not more than six inches high. They have opposite or whorled leaves, and flowers in dense flat clusters. The fertile flowers are small and greenish-white, but the cluster is surrounded by large, white or pink, petal-like bracts. This makes the flower cluster showy and is the most striking feature of the genus. The fruit is a drupe with a flat stone.

The wood is hard and used for making small articles and the bitter, astringent bark is used in medicine. Most of the members of the genus make ornamental trees or shrubs.

1. Western Dogwood. Cornus Nuttallii. Audubon.

The dogwoods are all beautiful and this tree of the Pacific coast region is one of the handsomest of the group. It grows sometimes ninety feet high and two feet in diameter. The bark is about a quarter of an inch thick, reddish-brown, slightly roughened and scaly. The twigs are green and hairy when young and red-brown or purple when mature. The flowers are in dense heads surrounded by from four to six showy white or pink bracts, each about two inches long and an inch or more

wide. The whole cluster resembles a huge flower and is generally so called. This bloom, which usually appears in the spring, gives the tree a beauty all its own. It is still more striking, however, when these blossom-like clusters appear in the fall, as they sometimes do, mingling with the scarlet fruit of the spring bloom. It is a trick that many of the dogwoods have, this production of fall bloom. This passes unnoticed by most people in an obscure shrub like the red osier dogwood of the prairie, but excites comment when done by its showy relative of the western coast.

Fig. 49. — Western Dogwood.

The fruit is a red or orange, rather flat drupe with the persistent calyx teeth adhering to it. These are crowded in heads of about thirty or forty together.

The wood is hard, takes a good finish, and is used in light furniture. It need hardly be said that this beautiful tree is popular for ornamental planting within its range, but unfortunately it does not transplant well to other climates. It is found in the southern part of the coast region of British Columbia and southward, and reaches its best development in the northern part of its range.

THE OLIVE FAMILY. OLEACEÆ

This is a very large family, all its members being trees or shrubs, and many of them tropical. It has no native Canadian members except the ashes, but the lilacs, introduced from Europe or Asia, also belong here.

I. The Ashes

Genus Fraxinus

The ashes are graceful forest trees with straight trunks, rather thin, rough, scaly, gray bark and opposite compound leaves with from three to eleven leaflets. The flowers are small, inconspicuous, mostly with no petals and appear with or before the leaves. The fruit is a single samara, the wing at least partly surrounding the seed.

The wood is light, straight-grained and splits easily. In some species it is strong and much valued for handles of forks and other similar tools.

1. Black Ash. Fraxinus nigra. Marshall.

The black ash is a tree of the swamps or low places. It often grows eighty feet high, with a stout straight trunk, covered with thin, gray, scaly bark, not broken into distinct ridges. The leaflets number from seven to eleven, and all except the terminal one are sessile. The wing of the samara runs entirely around the seed.

The wood is tough but weak, and splits very freely along the grain. It was formerly the timber most used by the cooper.

Barrels, tubs and particularly barrel hoops were made from it. The depletion of the supply, however, has left very little timber sufficiently clear for this purpose. It is also used for furniture and interior finishing of houses.

The black ash is mostly an eastern tree, but extends into Manitoba in the wooded regions and along the river valleys across the province, particularly about the latitude of the larger lakes.

As an ornamental tree it has never been much tried. A few planted in the Normal School grounds in Brandon four years ago are living but growing very slowly.

FIG. 50. — Black Ash.

FIG. 51. — Green Ash.

2. GREEN ASH. Fraxinus pennsylvanica. var. lanceolata (Borkhausen). Sargent.

This is a small tree with rather thick, rough, gray bark and smooth twigs. The leaves have from five to nine leaflets, ovate or lanceolate in shape, and sessile or almost so. The wing of the samara runs about halfway down the seed.

This tree grows in the valleys of the Red, Assiniboine, Qu'Appelle and Souris rivers, as well as in the Pembina and Moose Mountains and the eastern part of the Dirt Hills. It prefers good ground and moist locations, and under favorable condi-

tions reaches a diameter of eighteen inches to two feet. It does not cast a good shade, so that if planted alone grass is likely to grow beneath the trees. This makes it advisable always to mix green ash with other trees to get a good cover for the ground.

The wood is used locally but mostly for fuel, and it has proved a satisfactory tree for street or lawn planting. It can be grown easily from seed and when young grows rapidly. It is very late in getting its leaves in the spring and loses them early in the fall. This is, perhaps, its worst feature as an ornamental tree.

The Red Ash (F. pennsylvanica), the type of the species of which the green ash is a variety, has been reported as growing along the Red river and westward, but the only specimen I have seen was sent to me by Dr. Buller, Professor of Botany in Manitoba University. It was collected by him at Victoria Beach on Lake Winnipeg. It differs from the variety in having velvety petioles and twigs, and broader leaflets on distinct petioles.

3. Oregon Ash. Fraxinus oregona. Nuttall.

This tree may be looked for in southern British Columbia, as its range includes the whole of the states to the south. It is a fairly large tree, with rough gray or brown bark and leaves of five to nine, mostly seven, leaflets. The leaflets are sessile, ovate and blunt-pointed. The wing of the samara runs down along the seed to the middle or farther.

The wood of this tree is valuable, being used much as black ash is used in the eastern part of the continent. It is also largely used for street planting.

THE HEATH FAMILY. ERICACEÆ

The heaths are a family of shrubs. Scattered all over the northern hemisphere, they are widely spread and numerous, but never herbs, and only in a few cases reaching the size of even a small tree.

They have simple, alternate, leathery and often evergreen leaves. The flowers are clustered in a variety of ways, the stamens always equal to or twice the number of the petals, the carpels united to form a compound ovary with a single style. The fruit may be a berry, a drupe or a hard woody capsule.

The heaths produce many plants of value in medicine and other ways. The wintergreen flavoring, now prepared from the cherry birch, was originally the product of the aromatic wintergreen, a small heath seldom more than six inches high. It is to this family, too, that we owe the fruit of the cranberries and blueberries, and the flowers of the sheep laurels, azaleas and rhododendrons.

I. The Madroñas

Genus Arbutus

So far as North America is concerned no arbutus occurs native on the eastern side of the continent. It is a small genus of ornamental trees or shrubs, mostly confined to the warm or warm temperate parts of the earth.

Its members have simple, alternate, entire, evergreen leaves, and flowers in raceme-like clusters at the ends of the branches. The calyx is five-parted and persistent, the corolla five-toothed

and urn-shaped, and the fruit a sort of drupe in which the flesh is dry and powdery. They are useful only for decorative purposes.

1. MADROÑA. Arbutus Menziesii. Pursh.

This is said to be the largest and most beautiful member of the heath family. It is an evergreen tree sometimes nearly one hundred feet high, but usually smaller and rather slender.

FIG. 52. — Madroña.

It has a straight clean trunk, rather stout, often ascending branches, red bark and twigs. The outer bark often breaks away and peels off in patches. The leaves are rather thick and leathery, shining green above but paler beneath, and the margins turned in toward the under side. The flowers are white and the fruit bright orange.

The wood and bark of this tree have had a limited use in the arts and in medicine, but its chief value continues to be in its beauty.

In Canada it is found on Vancouver Island and the coast of the mainland immediately facing on the Gulf of Georgia, as well as on the islands of the gulf. In no case is it found far from the coast.

THE BUCKTHORN FAMILY. RHAMNACEÆ

This is a large family comprising many shrubs and vines and a few rather small trees. Many of its members are ornamental and others yield valuable drugs, but they produce no timber.

Shrubs or trees of this family are most easily recognized by their alternate simple leaves which are very prominently and characteristically veined, their bitter astringent bark and small, regular, sometimes imperfect flowers followed by dry drupelike fruit.

I. The Buckthorns

Genus Rhamnus

The buckthorns are the type plants of the family. They are almost all shrubs but a few are small trees. They have simple alternate leaves and small greenish flowers clustered in the axils. A peculiarity of the flower is that each petal is wrapped about a stamen. The bark is bitter, and some species furnish extracts of medicinal value.

Fig. 53. — Buckthorn.

1. Buckthorn. Rhamnus Purshiana. De Candolle.

This is very often a shrub but at times grows to a small tree. It has thin, brown, scaly bark and reddish-brown branches. When young the twigs are green and covered with fine hairs. The leaves are oblong, often blunt-pointed and finely toothed. They are dark green above, usu-

ally yellowish-green beneath, and supported on short petioles. The flowers generally appear in the spring or early summer, but sometimes continue to appear until almost the end of the season. The fruit is round, black and juicy, and contains three nutlets.

The wood of this tree is of no commercial value, but from the bark is prepared the cascara of commerce. This makes the tree one of the important drug-producing plants of the world.

It occurs along streams and on wooded mountain slopes in the coast region of southern British Columbia.

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